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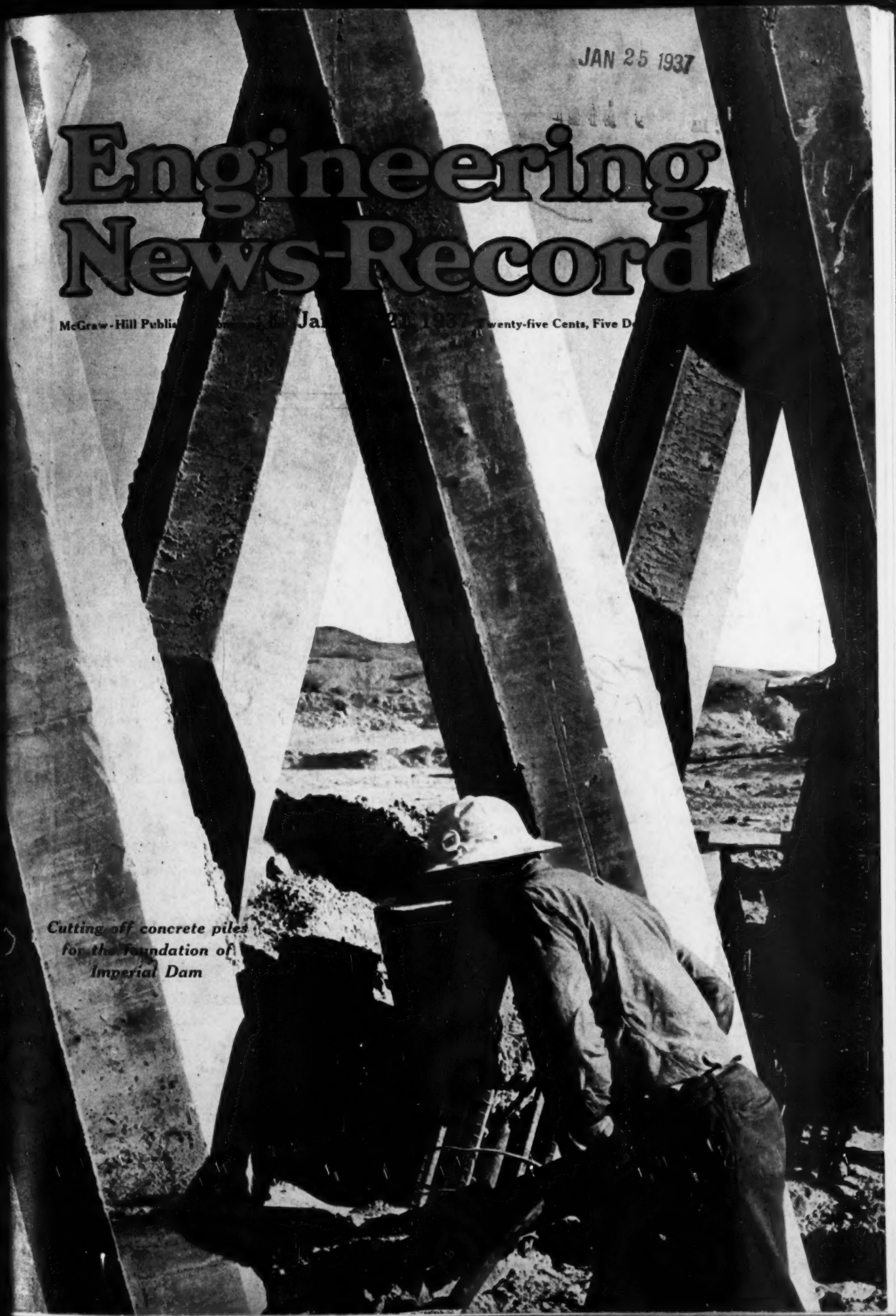
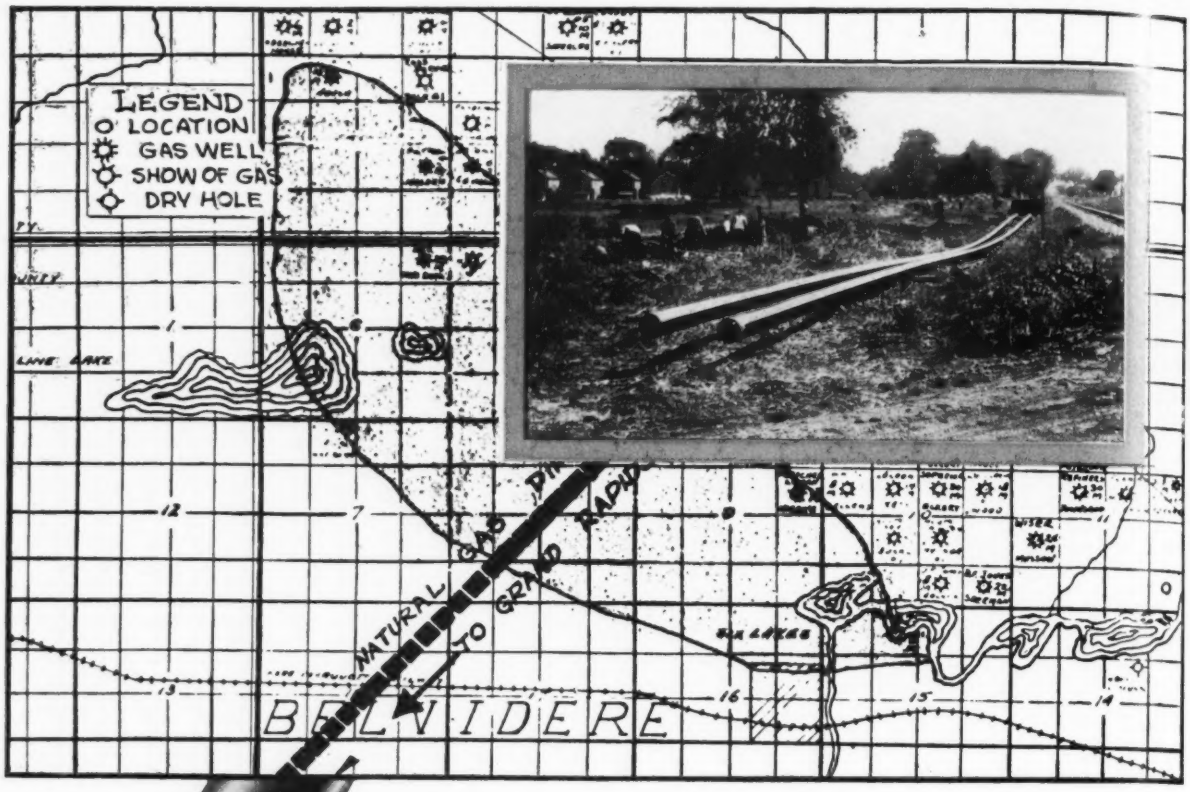


Cutting off concrete piles for the foundation of Imperial Dam



Republic LINE PIPE BRINGS NATURAL GAS TO GRAND RAPIDS

Over hill and through valley — across swamps (eighteen of them) — over quicksands — across rivers goes Republic Electric Weld Line Pipe — 37 miles of $10\frac{3}{4}$ in. O. D. — to bring natural gas from the Hinton-Belvidere-Milbrook county field to Grand Rapids, Michigan. The entire line is welded — constructed for 450 lbs. pressure. Innumerable over-bends and side-bends were made cold in the field with the use of tractors, winches and trucks.

Again this modern, mechanically-perfect, electric resistance welded pipe leaves its indelible mark on the gas map of the nation. And with the construction engineers and superintendents — with the gas company officials — it leaves remembrance of its perfect roundness, uniform wall thickness, 100% weld, high yield with high ductility, weldability and lengths up to 50 feet without mid-weld. Let us tell you why you, too, should use it.

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GENERAL OFFICES . . . CLEVELAND, OHIO

REPUBLIC STEEL

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WHY CANCEL a National Asset?

IN a recent release the Public Works Administration presents an analysis of the employment created by its activities away from the site of the job itself. It shows that in the construction of non-federal projects, PWA has created in the private industries supplying materials, 2½ times more work than it has in the building trades themselves. This is based on ratios established by the Bureau of Labor Statistics of the Department of Labor.

During the period that a federal public works program was under discussion its advocates frequently declared that its *indirect* employment would be of substantial support to the hard pressed and all important capital goods industries. Seldom, however, was anyone so bold as to suggest a 2½ to 1 ratio; usually 2 to 1 was suggested as most probable. Now the record shows that to December 1, 1936, a total of 1,264,379,500 man-hours of *indirect* labor had resulted from field employment amounting to 505,751,800 man-hours. Thus the contentions of the public works advocates have been more than justified.

MORE noteworthy, perhaps, than the volume of the indirect employment is its widespread distribution. In some measure, every state in the Union appears as a beneficiary, in the employment of its people in factories, mines, mills, shops and forests, producing, fabricating and transporting materials. Each has benefitted from operations remote from its own borders.

Despite all this we have the spectacle now and then of state officials, of greater or less influence, holding forth on the desirability of their citizens becoming "state conscious" in their buying. If there is any one notion that we should *not* foster it is that one. To become "state conscious" in their buying probably would do more harm to *all* the people of the United States than almost any other state of mind. One of the surest means by which to cancel out our economic gains of the last century would be to draw lines between products and services produced "at home" and "abroad."

With the example of Europe before us it is difficult to understand why anyone should suggest such a course. Over there we see a continent cut up, not only into political units but also into economic units. Each of these is striving constantly for economic self-sufficiency. Each is building trade walls about itself and fostering trade jealousies. In other words, their people are being made very "state conscious" in their buying. And as a part of the process they are being trained to self-denial and self-discipline in the name of patriotic devotion. In lieu of higher living standards they are offered a diet of suspicion and distrust of their neighbors.

THIS observation is offered in no spirit of unkind criticism, for every fair-minded observer must sympathize with those millions of souls who suffer from conditions that have their roots deep in the past. For years their most far-seeing statesmen have tried to mitigate those conditions and to reproduce on the continent of Europe something akin to the free intercourse that prevails between the people of our states.

So why should any American want to instill into our people even a trace of the sectionalism that can nourish so great a distress? However onerous may be our own peculiar problems, the fact remains that they are problems of abundance rather than of scarcity. Despite our distresses, our people generally still enjoy a standard of living that is the envy of the Old World.

And one of the chief reasons for that advantage is the absence of trade boundaries within our vast area. The founders were thinking straight when, after their grief under the Confederation, they provided in the Constitution against state tariffs that might destroy the economic unity of the nation.

And it is the part neither of wisdom nor progress to instill in our people, through appeals to state prejudice, a notion that has done so much harm both abroad and at home and that has, therefore, been denied legal sanction by the federal Constitution.

Willard Chevalier

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40 POINT PROTECTION WITH TIMKEN BEARINGS

On the tough job of widening the Chattahoochee River near West Point, Georgia, the contractors, Hardaway Contracting Company, have found Lima Draglines equipped with TIMKEN Bearings equal to every requirement. They report ample power for heavy loads combined with light cable use — two important factors of economy in dragline operation.

TIMKEN Bearings are installed at 40 important bearing points in these machines. Their use has a profound effect on performance, endurance and low maintenance cost by practically eliminating friction and wear; protecting the equipment against radial, thrust and combined loads; and holding moving parts in correct and constant alignment.

For the same reasons you will find TIMKEN Bearings dominant in all kinds of construction equipment. It will pay you to make sure your new machines are Timken-equipped.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Tubing; and Timken Rock Bits.

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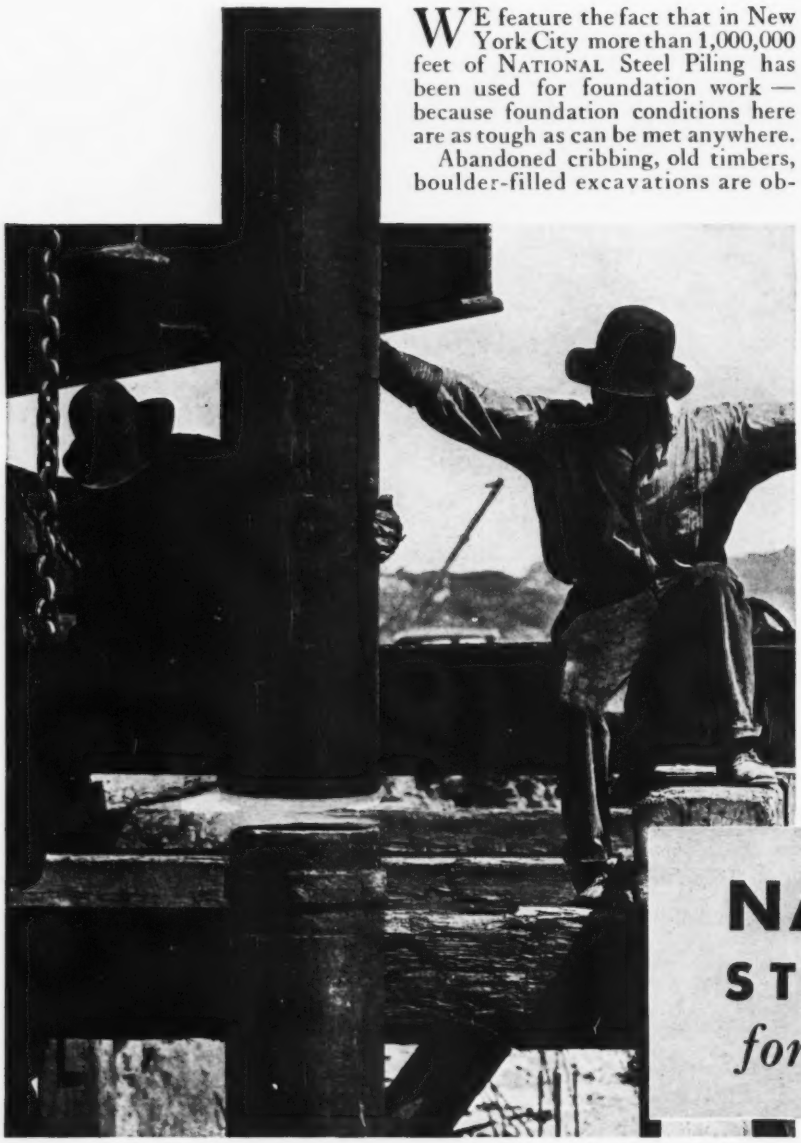
The Cover Picture this week was taken in the forest of concrete piles driven into the silt bed of the Colorado River for part of the foundation of Imperial Dam. Progress on the dam is reported on page 92.

NEXT WEEK—a significant contribution to the art of aqueduct design—the first of two articles by Julian Hinds.

IN NEW YORK ALONE . . .

One million feet!



WE feature the fact that in New York City more than 1,000,000 feet of NATIONAL Steel Piling has been used for foundation work — because foundation conditions here are as tough as can be met anywhere.

Abandoned cribbing, old timbers, boulder-filled excavations are obstructions that must be penetrated, often to depths of 200 feet or more. A typical example is the Elevated Public Highway from Canal Street to West 23rd, on which 17 miles of NATIONAL Seamless Pipe was driven without a single failure — a job on which efforts to drive other types of piling, ordinarily satisfactory, had to be abandoned.

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UNITED STATES STEEL

ENGINEERING NEWS-RECORD
January 21, 1937

ATTRACTIVE COMMUNITY of 202 homes created at Meadville, Pa., in eight months by large-building construction management.

Mass Production of Frame Houses

Large building contractor transforms wooded hillside into community of 202 modern homes in eight months at Meadville, Pa.

APPLICATION of straight-line operations of large building construction to small house erection resulted in completion of the million-dollar Hillcrest housing project at Meadville, Pa., in remarkably fast time. At start of work on April 4, 1936, the site of the project was a steep hillside of farm and woodland, without utility service of any kind. On Dec. 4, just eight months later, the last of 202 family units consisting of 178 frame houses and 27 groups of multiple garages was ready for occupancy. Paved streets and walks, sewers and storm drains, water, gas, light and telephone service and extensive landscaping along with the variation in house design and color, make the development an attractive, modern and highly desirable community. The Hegeman-Harris Co., of New York, general contractor on the project, sublet all of the work. Construction costs totaled $756,000, an average of 3,743 per unit, the units ranging from four to six rooms per house.

Unique project

The project is unique in every respect —promotion, financing, planning and construction. Meadville, situated 41 mi. southeast of Erie in the northwest part of the state, has a population of about 20,000. Within the past few years the expansion of two large industries located in the town, the Hookless Fastener Co. and the Viscose Co., created a serious shortage of housing. Not only was there a complete lack of accommodations for many people desiring to live in town, but there was also a distinct shortage of medium and higher class houses. Consequently, a considerable number employed in the city were forced to find accommodation in outlying districts, 1,400 of them going more than eight miles away, while others had to live in low-class houses within the city that are poorer accommodations than the economic status of their occupants warrant.

To relieve this situation the Meadville Housing Corp. was formed late in 1934, with the Chamber of Commerce and the Meadville Central Labor Union as sponsors. A year of promotional activity culminated in final plans for the Hillcrest development. All officers of the corporation are prominent citizens, who serve without pay. The corporation sold stock to 97 individuals and firms in amounts from $100 to $100,000 each, aggregating $212,000. A mortgage loan of $800,000 was obtained from the state compensation insurance fund at 4 per cent interest, making a total of $1,012,000 available for the project. The loan was insured by the Federal Housing Administration, at a 4 per cent interest rate which is lower than for any similar project. The loan is to be amortized in 30 years, and stockholders have agreed to waive all interest and dividends until the loan is paid off. Stockholders then come into full possession of the property, no part of which is to be sold until that time.

General plan

FHA regulations required that the project be built on a single tract of land, which must lie entirely within the city limits. A tract meeting these requirements was found along the eastern city limits, consisting of 43 acres in 27 separate parcels. The site was a steeply sloping hillside, exposed to the south, consisting of farm and wood land. The corporation bought the entire 43 acres, donated 11 acres along the west side to the city for park purposes, reserved 5 acres for future development and for protection against encroachment, and built upon the remaining 27 acres. No sewer, water, gas or light facilities existed in the tract prior to the development.

Naturally, serious consideration was given the type of housing to be built. There was need for housing extremely low cost, of the row or group type, that would be occupied by the low-income class of worker. However, the corporation finally decided that a higher-type class of building, largely of individual homes of moderate cost, would serve

the city's need best and furthermore would be a desirable addition to the community and encourage rather than retard better-class home building in that section of the city.

To provide variety in appearance and a range of rental scales, plans were drawn for eight different types of houses of four, five and six rooms, all with bath, to rent from $30 to $46 per month, or from $7.08 to $7.70 per room. Garage rent of $2.50 is extra, except for the 46 homes which have garages attached. There are 202 family units in 178 buildings; 48 of the 5-room units are in double houses. The number of units of different size and their rental schedules are given in Table 1.

Architectural design

All houses are of two-story frame construction, with wood shingle roofs, and clapboard or shingle siding. Foundations are of light-weight concrete blocks resting on 6x16-in. poured-concrete footings. All cellars are full size, with 3-in. concrete floors. Exteriors are extremely plain, broken only by small porches, some uncovered, and brightly-painted blinds. There are no projecting eaves, gutters or down spouts; the roof runoff is taken care of by a 12-in. brick-paved splash plate on the lawn directly under the eaves.

Floor joists are 2x8-in.; studs, ceiling joists, rafters and partition framing are 2x4-in., all 16 in. c. to c. Clear height of stories is 6 ft. 10½ in. in the basement, and 7 ft. 4 in. in the first and second floors. Attic space is not finished, nor is it readily accessible. Diagonal sheathing is used under shingled exteriors only, otherwise the clapboards are nailed directly to the studding over ½-in. insulating board. All walls are plastered over metal lath backed by insulation. Flooring is oak, placed over a sub-floor.

Windows are double-hung wood sash, fitted with storm sash throughout. Doors are also protected by storm doors. Interior walls are papered to suit the tenant.

Equipment installed in the houses follows local custom. As natural gas is a common fuel, 150 homes have been fitted with gas-fired hot air furnaces, manually controlled. To accommodate the occasional renter who does not like gas heat, 52 coal-burning hot air furnaces have been installed. Each house has a gas-burning fireplace in a wooden mantle, but in line with usual local procedure no gas ranges or refrigerators are provided. Laundry trays are installed in the basement, and each kitchen is equipped with a sink and built-in cabinets. All bathrooms are identical in size and furnishings. Water piping is copper, even to the house connections and long laterals from the mains. Light fixtures are uniform, including both wall and overhead fixtures, and plenty of wall outlets are provided.

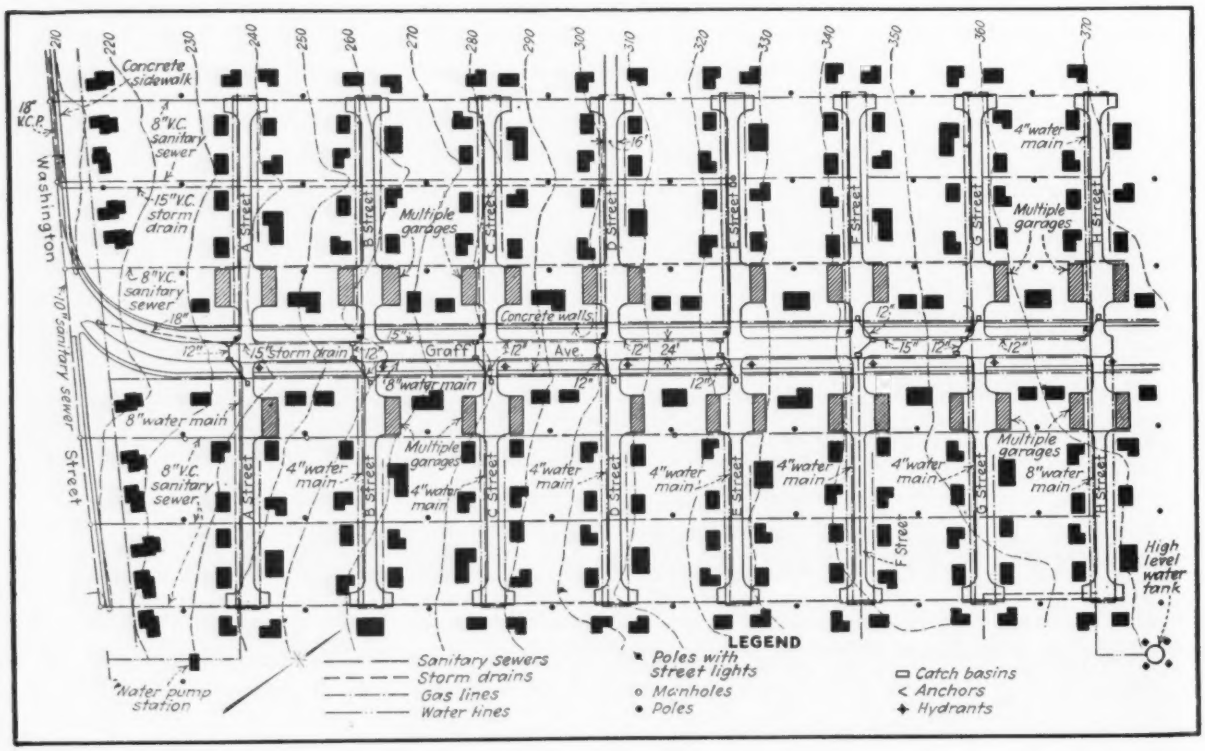
DEAD-END STREETS served by one main thoroughfare give the Meadville development a distinctive and unusual plot arrangement. Note the location of the multiple garages, near the main street. The contours are those of the original site prior to grading the hillside into terraces.

The broad expanse of sloping hillside offered unusual opportunity for a distinctive plot layout. Planning started from scratch, as there were no developed streets, sewers, water or pole lines to hamper or restrict the arrangement of plots. Once the type and size of the individual houses was determined, the next step in planning was the most effective placement of the buildings on the available land.

Unusual plot arrangement

The general plan finally adopted was to establish a main paved street running directly up the hill, splitting the building property into two equal parts. Extending for a block each side of this main street are eight parallel, and nearly level side streets, built as *cul-de-sacs* or dead-end roadways with a wide turn-around space provided at their extreme ends. To keep local traffic off the side streets, the group garage units were placed at the intersection of the main and side streets. Comparatively few houses, 24 in all, face the main street. The others, except for eleven bordering on a state highway at the lower end of the property, are located on terraces facing the side streets. The corporation seeded all lawns and terraces, and planted over 700 trees and 2,400 shrubs.

The main street is paved 24 ft. wide between concrete curbs with asphalt filled brick on a concrete base. Concrete sidewalks 4 ft. wide parallel the paving, separated from it by a wide parking strip. The side streets are unusual in that they are paved with a



RAPID PROGRESS achieved in constructing the Meadville development is shown by these two views. The upper view shows the site shortly after start of work on the sewer and water lines; six weeks later framing of units on half of the site was about complete.

16-ft. concrete slab without curbing, dished at the center for drainage. No sidewalks are provided in the side streets, but there are concrete steps and walks from house to roadway.

Except the eleven plots facing the state highway, all individual lots are 60x80 ft., and the double houses are on double-size lots. The 4,800 sq.ft. of lot area compares favorably in net space to that of a standard size lot containing a garage and driveway.

Six sanitary sewer lines were laid the full length of the tract parallel to the main street. Three storm drain lines take care of all surface drainage. A pole line was run through the center of each half of the tract, carrying light and telephone wires. Street lights are provided at mid-point of each side street and at the main street intersections. As half of the property lies above the pressure level of the city water system, a pumping station is installed at the foot of the hill, to pump into an elevated steel tank at the upper end of the property, which serves the entire development.

Installing utilities

The general contract included everything from clearing the site to final finish landscaping, excepting installation of water and gas mains, light and telephone lines. As Meadville pays for water line extensions from water department revenues, with no assessment charges against the property served, the city water forces placed the mains. In this connection the city also installed the copper pipe water laterals, but not the house connections, though the corporation reimbursed the city for the cost of the laterals. The power, gas and telephone companies installed their own services.

Construction planning

Regarding the job as a large building project spread out horizontally instead of rising vertically, the general contractor planned the work for straight-line construction operations, and let the following main subcontracts:

1. Clearing, grading, cellar excavation and concrete footings, street paving and walks, sewers and landscaping. (Keystone Construction Co., Meadville.)
2. Masonry, including concrete block cellar walls and concrete cellar floors (Heller-Murray Co., Youngstown, Ohio).
3. Carpentry, including all framing, trim, floors, roofs and installation of millwork (George Dreyman, Inc., New York,—labor and miscellaneous material only; main material and mill work furnished by general contractor).
4. Lathing and plastering (George P. Smith, Pittsburgh).
5. Plumbing, including house connections (George H. Soffel, Pittsburgh).
6. Heating (Gust H. Krack & Son, Erie, Pa.)
7. Electric wiring and fixtures (C. G. Johnson Electric Construction Co., New York).
8. Painting, exterior and interior (O. V. Van Curan, Greenville, Pa.).
9. Built-up roofing on garages and supplying hardware (Baldwin and Welcomer, Meadville).
10. Supplying of millwork (C. C. Devore, Meadville).

Construction operations were planned to start at the foot of the hill on the western half of the tract, work up to the top on this side, and then start on the east half at the bottom, again working up the hill. With this plan in mind, the first operation was installation of sewers and storm drains on the west half. At the same time the gas and water lines were rushed by the gas company and city water forces.

The next definite operation was excavation of the cellars, done with pull-scoop shovels. Following close to the excavator was a concrete crew with a small mixer, which poured the wall footings.

Along with the utility and excavation work went the general lot grading, which was carried on largely by bulldozers and a power grader, aided by a power shovel or two. The principal grading job was to transform the natural hillside into a series of terraces, and grade for the streets. Grading work was kept clear of individual house construction, and some of it was not completed until the houses were finished. Access to the various lots was from two temporary roads along the outside boundaries of the tracts. Streets were not used as truckways, but were kept clear for grading and paving operations.

Following placing of the footings was masonry work on the concrete block walls and paving of the cellar floors. The walls were plastered on the outside with ½-in. mortar and damp-proofed with emulsified asphalt. Blocks were hauled from Pittsburgh by truck.

Framing the major task

As the framing of the houses was the major construction item, much attention was paid to organization of this part of the work. Some 140 car-

Durable and attractive homes at moderate cost resulted from careful planning and mass construction operations on the Hillcrest housing project at Meadville, Pa.

penters and 40 laborers made up the framing crew, divided into several gangs. One gang worked only on lower floor joists, another on the wall and roof framing, another on sideboarding, another on shingling. Still other gangs worked on exterior trim, interior trim and floors, and on the stairways.

To expedite progress the various carpenter forces were not only assigned to certain parts of the framing, but were kept on the same type of houses as far as possible. Once framing was under way, a steady progress of 15 completed houses a week (five days) was maintained.

Except for the floors and millwork, all lumber was eastern hemlock, shipped from Sheffield, Pa., 100 miles away, in lots averaging five carloads each. In designing the houses the architects planned for use of standard length lumber without waste. Lumber enough for a whole block of houses was ordered in one lot, and upon arrival was trucked to the center of that block. Here the carpenters did what cutting was necessary with electric hand-saws.

Electric wiring, plumbing and heating installation was carried along with carpenter work after the roof was in place. The carpenter crews, working on identical houses, soon learned the knack of cutting out openings for these services, another small but important item in the general progress.

Lathing, plastering, interior trim and floor installation followed the framing in rapid order. Exterior painting was done just as soon as the outside carpenter work was completed. Interior painting awaited installation of the various fixtures.

Final grading

While much of the grading was done early in the program, final grading, including that for the streets, and backfilling followed after all outside work around the houses was completed. Streets were paved after all heavy trucking was over. Some 12,000 cu.yd. of topsoil, stripped from the site, was stored and brought back as top dressing for the lawns and parkings.

Cost and quantities

Corporation officials estimate that the houses built under this plan cost 25 per cent less than individually-built houses of comparable size and quality. Economies were achieved not only in the mass labor production, but through large order purchasing of standard materials as well. All labor was union; rates varied from 40 to 75c. for laborers to $1.25 for masons and plasterers. Carpenters, electricians, painters and plumbers received $1 per hour. Maximum employment was 500. The amount of materials required is indicated by quantities given in Table II, showing a few of the larger items.

TABLE I—FEATURES OF HILLCREST HOUSING DEVELOPMENT

Type of Dwelling	No. of Units	No. of Rooms per Unit	Unit Gross Fl. Area, Sq. Ft.	Room Rent per Mo.	Unit Rent per Mo.
A — single	32	4	747	$7.50	$30.00
1B — double	28	5	828	7.20	36.00
2B — double	20	5	1,018	7.50	37.50
C — single	48	5	1,018	7.70	38.50
E — single	63	6	1,078	7.08	42.50
F — single	11	6	1,078	7.67	46.00

Note: Type F houses have attached garages; other houses are served by 27 groups of six garages each that rent for $2.50 per month.

TABLE II—PRINCIPAL QUANTITIES INVOLVED IN THE HILLCREST PROJECT

Excavation, cu. yd.	54,000
Dimension lumber, M f.b.m.	1,100
Lumber, 1x8-in. t&g., M f.b.m	490
Small lumber, M f.b.m.	77
Siding, M f.b.m.	345
Oak flooring, M f.b.m.	245
Shingles, squares	2,000
Foundation blocks, 8x18 in.	180,000
Plastering, sq. yd.	80,000
Windows	2,545
Doors	2,610
Electrical fixtures	2,300
Copper pipe, 1-in. laterals, l.f.	1,426
Copper pipe, ¾-in. laters, l.f.	2,066
Cast iron pipe, 8-in., l.f.	2,707
Cast iron pipe, 4-in., l.f.	5,718
Curb boxes and shutoff valves, each	202

(Additional quantities are given in Table III)

TABLE III—UNIT COSTS OF HILLCREST HOUSING PROJECT

Item and quan.	Unit cost
Conc. curb and gutter — 3,505 lin. ft.	$0.85
Rad. curb, 6x24 in.— 1,018 lin. ft.	.85
Steel curb guard, ¾x4 in.— 666 lin. ft.	.50
Brick pave., incl. 6-in. conc. base, asphalt filled on sand cushion — 3,671 sq. yd. and ½ cu. yd. grading per sq. yd.	3.35
Conc. pave., 6 in. reinf.— 15,035 sq. yd.	2.00
Vit. tile sewer, 10-in., — 1,018 lin. ft.	1.00
Vit. tile sewer, 8-in., — 9,142 lin. ft.	1.00
Vit. tile sewer, 6-in., — 3,781 lin. ft.	.80
Y-connections — 153, each	.75
Brick manholes, 4x4 ft.— 29, each	55.00
Vitrified tile storm drain, 18 in.— 398 lin. ft.	1.50
Vitrified tile storm drain, 15 in.— 1,611 lin. ft.	1.20
Vitrified tile storm drain, 12 in.— 1,652 lin. ft.	1.05
Vitrified tile storm drain, 24 in.— 75 lin. ft.	2.20
Comb. manhole and catch basin — 35, each	55.00
Sidewalks, 4-in. conc.— 40,095 sq. ft.	.16

Miscellaneous unit costs of several features are given in Table III.

Direction

Laurence B. Starr is president of the Meadville Housing Corp. M. W. Williams, secretary of the Chamber of Commerce, represents that body on the board of directors and is also secretary of the corporation. William B. Steen represents the Central Labor Union on the Board. E. A. and E. J. Phillips, of Meadville, were the architects. For the Hegeman-Harris Co., general contractors, Ralph R. Ogden was construction manager and R. M. Dawson was superintendent.

H. E. Sherwood was resident engineer for the Federal Housing Authority. Roy L. Phillips, city engineer, is engineer for the corporation and also represented the city. The city provided considerable engineering service without cost, and also furnished inspection of utilities and other outside work, for which the corporation paid. Additional inspection was furnished by the architects, the FHA and the general contractor.

Control of Private Wells Sought in New Jersey

EFFORTS are under way in New Jersey to regulate uncontrolled draft on underground waters especially to protect the water supplies of the southern part of the state now almost wholly dependent on wells. Use of groundwater for public supplies has long been under state control by statute, the regulatory power being vested in the state's water policy commission. Private wells are not under such control however. In certain of the principal artesian sand regions the absence of control is causing dangerous overdraft. The proposed legislation is intended to correct this condition.

Recent studies by the commission brought to light the danger that some of the water-bearing sands, especially in the Atlantic City region, may become salted because of excessive draft. Many of the large Atlantic City hotels have private wells from which large volumes of water are drawn, and much of this draft is on what is called the 800-ft. sand (lying at a depth of 750 to 950 ft. below sea level at the beach), one of the two main supply horizons of the region. However there is also large draft from underground storage by industrial plants in the various parts of the state. South of the Raritan River, in Monmouth County, the deep sands underlying the so-called Runyon area are being overdrawn, with a resulting threat to the water supply of Perth Amboy.

At various times in the past apprehensions concerning overdraft caused bills to be introduced in the legislature to extend state control to private wells drawing 100,000 gallons per day or more, but industrial interests opposed the bills and they failed to pass. The situation has now developed to the point where essential supplies are directly menaced and groundwater authorities believe that the safety of the supplies requires full control of wells in critical areas. Control bills now being drafted are expected to come before the next legislature.

Stress Theory and Fact Checked On Glued Laminated Timber Arches

By William A. Oliver
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ALTHOUGH laminated timber arches with glued joints were introduced in Germany as early as 1907, it is only within the last ten years that interest has been shown in them in the United States. This interest has been sufficient to stimulate several research studies, among them a series of tests made on relatively large models in the engineering experiment station of the University of Illinois. These tests were planned to compare the stresses obtained from strains measured on the specimen in the laboratory with the stresses computed by means of the elastic theory applied to two-hinged arches. Four arches with axes of quadratic parabola shape have thus far been tested. Their dimensions and general make-up are shown in the accompanying table.

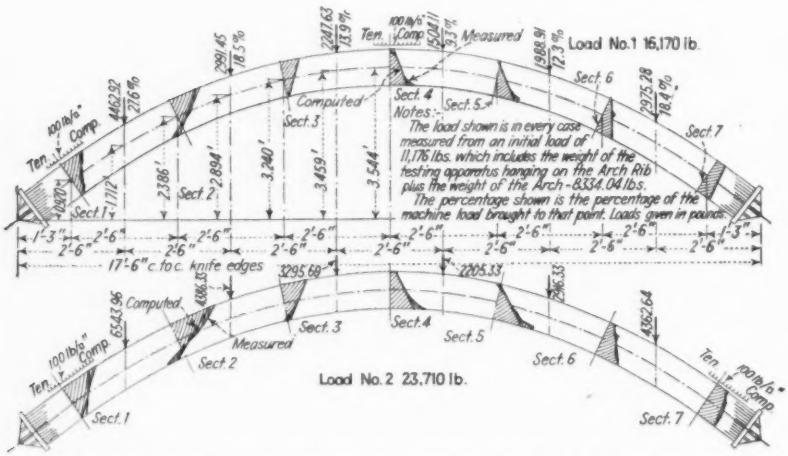


FIG. 1—RELATION between computed and measured stress in glued laminated timber arches tested at the University of Illinois

Dimensions and General Make Up of Timber Arch Specimens

Arch No.	Span ft.	Rise ft.	No. of Laminations	Thickness of Lamination in.	Size of Section in.
1	17.5	3.5	23	7/16	4½ x 10
2	17.5	3.5	13	25/32	4¼ x 10
3	17.5	3.5	13	25/32	4½ x 10
4	17.5	5.5	23	7/16	4½ x 10

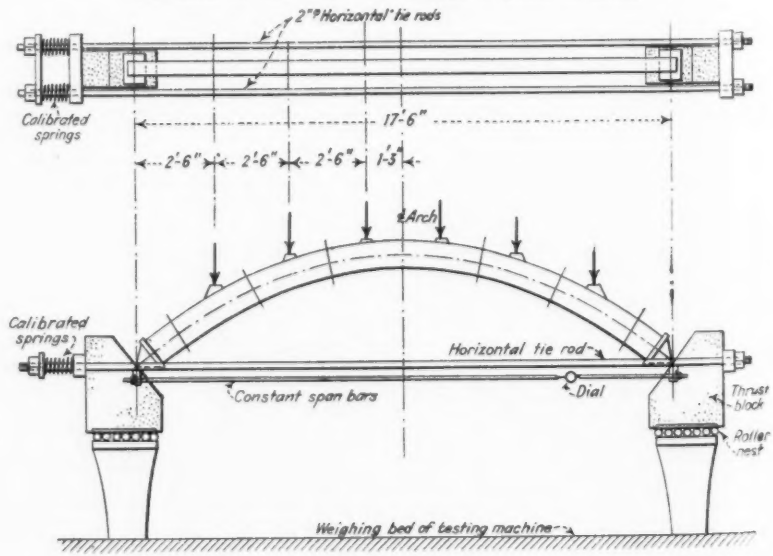
The specimens were all made of short-leaf yellow pine, straight grained, and with a density indicated by 20 to 40 per cent summer wood. The moisture content at the time of the testing averaged from 10 to 12 per cent. The average ultimate strength of 2x2x8-in. compression specimens cut from the arches subsequent to testing was from 9,000 to 10,000 lb. per sq.in. In the same series of compression tests, the average value of the modulus of elasticity was found to be 2,200,000 lb. per sq.in.

As shown in the table, all specimens had a section with nominal dimensions 4½x10 in. Without any preliminary treatment, the boards making up the laminations were bent to conform to the curved parabolic shape, with their broad sides perpendicular to the plane of the arch. They were cut to such lengths that their end joints could be staggered down through the depth of the arch symmetrical about the center-line. Just enough nails were used at the ends of the boards to hold them in place while applying the glue and setting the clamps. A casein glue was used.

The two-hinged, unbraced ribs were loaded in a 300,000-lb. testing machine, the load from the movable head being distributed to the six arch load points of Fig. 2 by a system of levers hanging on each side of the rib. The two reaction hinges were hardened steel knife edges embedded in steel castings which were clamped, one at each end of the specimen. The knife edges bore on second steel castings embedded in heavy concrete thrust blocks. Horizontal thrust was resisted by tying the two concrete blocks together with two 2-in. diameter nickel steel rods. Calibrated coil springs on each tie rod furnished a means of measuring the horizontal thrust, while the testing machine weighed the vertical reactions.

Testing procedure was as follows: An initial load including the dead load weight of the testing apparatus was applied to the specimen, and a set of readings taken. This consisted of a strain gage reading on every lamination on both sides of the arch at the seven strain sections, a reading on each horizontal thrust spring and, in testing arch 4, some measurements were also taken of slip between laminations. This initial load in combination with its corresponding set of readings was used as the point of reference from which all subsequent loads and readings were measured, so that all plotted or tabulated data show the effect of change in load rather than the effect of absolute load. Strains were measured on a

FIG. 2—TEST SET-UP of laminated timber arches. Testing machine load was transferred to arch load points through a system of levers.



4-in. gage length between small nails on arches 1 and 2 and special plugs on arches 3 and 4; the plugs gave more reliable results.

The determination of horizontal thrust was an important part of the tests. In this part of the work a constant span was maintained by eliminating the effect of the elasticity of the tie rods. Measured and computed values of horizontal thrust checked each other very closely, indicating that the specimen was behaving in a manner simiar to an ideal theoretical arch of equal dimensions.

Stress distribution

A graph showing the relation between computed and measured stress—the latter determined from measured strains—is shown in Fig. 1. The stress distribution shown by the straight line is, of course, the computed value. Here, again, fairly close accord is apparent between the measured and calculated conditions existing in the specimen. The discrepancies between these values may be due to any one or all of the following factors: (1) Effect of joints in the laminations, (2) slipping of the lamination due to poor gluing, (3) lack of uniformity in the material, (4) variations due to testing procedure, (5) stressing of the material beyond the proportional limit and, (6) shifting of the neutral axis, typical of timber beams. Probably the most important factors causing disagreement are (1) and (2).

As would be expected, increased loads producing stresses beyond the proportional limit caused greater differences between measured and computed values.

Arch 1 failed at a total ultimate load of 101,356 lb., arch 2 at 136,586 lb., and arch 3 at 114,000 lb. The investigation of arch 4 was not completed when this article was written.

The technique of fabricating and gluing the type of structural unit used in these tests has been greatly improved since the specimens were made. Preparations for tests of a two-hinged rigid frame are now under way, and these specimens show very decided improvement over the arch specimens already tested. The joints in the laminations are greatly improved, having been scarfed diagonally and end-glued in the new specimens. In the specimens thus far tested, however, the results obtained show very well that this form of construction has some interesting possibilities.

The specimens were furnished and the tests partially financed by the national committee on wood utilization, which was formerly a committee of the U. S. Department of Commerce with Axel H. Oxholm as director. N. S. Perkins, formerly construction engineer for the committee, superintended the fabrication of the specimens and acted in an advisory capacity. The Casein Manufacturing Co., Bainbridge, N. Y., furnished materials and technical advice. M. L. Enger is director of the engineering experiment station of the University of Illinois. The writer was in direct charge of the tests under the general supervision of W. C. Huntington, head of the department of civil engineering.

Financing Large Scale Housing With FHA Mortgages

INSURED MORTGAGE financing of large-scale housing has exhibited a desirable adaptability to the requirements of investors and to local housing needs, according to a recent compilation of current financing plans made by Martin J. Roess, Jr., counsel, large-scale housing division, Federal Housing Administration. The projects range in type from five-story elevator apartments to groups of single family dwellings and in cost from $320,000 to $2,355,000.

When ground was broken recently for the $1,500,000 project known as Chester Crest Apartments, Inc., in Westchester County, N. Y., it marked the first participation of New York City bankers in the financing of large-scale apartment developments erected under the FHA program. The Manufacturers Trust Co. is furnishing the funds for the construction of the two five-story elevator buildings required in which 279 families will be accommodated at rents of $18 per room per month. The amount of the insured mortgage loan is $1,150,000, and the RFC Mortgage Co. has agreed, upon completion of the buildings and the fulfillment of certain other conditions, to purchase the mortgage at its par value in event the Manufacturers Trust Co. desires to sell. As construction proceeds funds are being advanced, and these successive advances to the builder receive the benefits of mortgage insurance. Except in large-scale housing financing, mortgage insurance is not granted until the construction of the building is completed.

Another large-scale housing development of quite different type is now under construction at Crossett, Ark., to provide 199 single-family dwellings at an average rental of $4.70 per room per month. In this case, three local banks desired to invest in the insured mortgage. To enable them to do so, the mortgage was issued in the form of first-mortgage insured bonds in denominations of $1,000 each. These were secured by a deed of trust, a disinterested local bank acting as trustee. Through this procedure the Crossett Housing Corp., which sponsored the project, was able to sell its bonds to the three banks at par, obtaining the needed funds at 4½ per cent interest and on terms which permitted repayment over a long period of years.

A still different type of financing was used in Meadville, Pa. In this case a semi-public body — the Pennsylvania State Workmen's Insurance Board—wished to invest its trust funds in an insured mortgage issued by the Meadville Housing Corp. but did not wish to make advances as construction proceeded or to participate in any way in the construction phase of the development. In this instance, the board merely delivered its check and received a 4 per cent insured bond and mortgage in the sum of $800,000. The board was represented by the Provident Trust Co. of Philadelphia, which held the proceeds of the check in escrow and disbursed funds from time to time as construction proceeded and upon the authority of the Federal Housing Administrator. The project involved the construction of 202 single-family frame houses to rent at an average of $7.28 per room per month. (See page 77)

In still another case, that of Colonial Village, Inc., and Colonial Village Extension, Inc., at Arlington, Va., the projects secured two insured mortgages in which the New York Life Insurance Co., has invested a total of $2,325,000. These projects involved the construction of 738 two-story walk-up apartments to rent at $13 per room per month. In this case there was no intermediate construction loan nor were the proceeds of the mortgage disbursed from an escrow account by a fiscal agent, the New York Life Insurance Co merely paying the funds directly to the housing corporation upon certificates of approval issued by the Federal Housing Administrator. The advances were insured as made, so that the lender's risk was reduced to a minimum.

Mr. Roess points out that, in addition to the flexibility of financing methods, the adaptability of insured mortgages to meet the different needs of classes of investors is enhanced by the fact that under Section 5136 of the Revised General Statutes, first mortgage bonds issued against large-scale housing projects and insured under Section 207 of the National Housing Act may be purchased and otherwise dealt in by national banks and most other financing institutions on the same basis and under the same conditions as bonds of the Home Owners Loan Corp.

Oil-Stabilization of Road Bases Under Test in Missouri

Indications of field trials of methods for stabilization of the bases of low-cost roads point to rules of practice of fairly conclusive character

By F. V. Reagel and R. C. Schappler

Engineer, and Assistant Engineer of Materials State Highway Department, Jefferson City, Mo.

SOIL-BASE STABILIZATION *with bitumen has taken a pronounced forward step in mechanization in Missouri practice. The machines used and the methods employed are succinctly described by the engineers who have supervised the experiments in the following article condensed from a paper presented at the recent annual meeting of the Highway Research Board. The article has very definite significance to the roadbuilder: It indicates the advancing tide of soil-base stabilization activity; it emphasizes the increasing volume of evidence of the wide variety of soils capable of stabilization, and it indicates that the equipment engineer is conveniently providing the inventiveness that mechanization of construction processes requires. An art of soil stabilization is being developed in step with progress of soil science research.* —EDITOR.

IF WE ARE CORRECT in the assumption that a durable waterproofed thickness of soil is of just as much value (aside from failure to resist the abrasion of traffic) as an equivalent thickness of high-type surface (again discounting beam strength) we are forced to just one conclusion: Concentrate on the base and work in the direction of water-proofed bases plus relatively thin renewable cover coats as a solution to our low-cost road problem. We can get at this thin renewable surface to preserve or improve it but it costs to work on the base after the top has once been placed.

This is the line of reasoning on which we are basing our plan of research attack on the low-cost road problem. Considering only the bituminous angle, can we add sufficient oil to a sufficient thickness to waterproof a soil durably without inducing a plastic condition and thereby losing the inherent stability? If not, can the plasticity so induced be overcome by the addition of an economical amount of friction material?

Based on the conception of the problem as stated above, attempts were made in the Missouri laboratory to develop by means of laboratory manipulation optimum quantities and types of treating agents and conditions of treatment. This work, in its early stages, failed to develop the desired information. Interpretations were clouded by the vast difference between laboratory manipulations and the simple field treatments desired in practice. It was found very difficult, if not impossible to duplicate field conditions satisfactorily in the laboratory.

Information was and is lacking in regard to field moisture conditions, and the extent and character of the curing of bitumen over periods of time are a matter of conjecture. Both items may be presumed to influence stability values.

Laboratory indications did, however, develop that absorptions decrease with increasing bitumen content and that the optimum bitumen range is shown by stability measurements. This range is roughly 6 to 10 per cent based on soil fines (passing 40-mesh sieve). However, the results are clouded by the influence of the moisture content at the time of the test, the degree or extent of curing and the nature of the fines present. The presence of clay in the system gives higher stability measurements and this is considered consistent with the conception of cohesion.

Following the preliminary laboratory work, development of test sections was considered necessary and, during the season of 1935, two major test roads were planned and constructed. Early during the year 1936, these roads were covered with a light seal or armor coat and are now under observation as a service test. The two methods used may be described as follows:

Suboiling machine method

The Ingalls or subterranean method of suboiling is a method for the deposition of a quantity of liquid bituminous material or other treating agent at the bottom of a scarified layer of earth, or of earth covered with granular surfacing, followed by compaction to permit the oil to permeate upward and diffuse through the mass. Later manipulation may or may not be necessary.

This method in principle was, insofar as we know, first conceived by Mr. Ingalls in connection with the hauling of heavy equipment in the western oil fields. Its first trial in Missouri was by Alex F. Sachs, county engineer of Jackson County, on short stretches of earth and of earth covered with crushed-stone surfacing. After promising indications were observed on these stretches, constructed during the summer of 1935, ten miles of experimental sections were constructed on the Missouri state highway system in Platte County.

The method as now developed consists essentially of scarifying the existing roadway to a depth of four or five inches, followed by the introduction of the bituminous material with or without the prior or subsequent application of a small amount of water or soap solution. Following the application, the roadway is kept smooth under traffic and rolled as necessary to obtain the desired compaction.

The equipment for application consists of a heavy frame supporting hollow curved teeth which project down to the desired depth and through which the bituminous material from an accompanying distributor is forced by means of a pump mounted on the rear of the applicator.

The bituminous material added included SC oils, MC oils, MC oils emulsified, and commercial emulsions. Specifications of these materials are given in the accompanying table. The quantities vary from 5 to 15 per cent of oil by weight of the layer treated, based on percentage of the material passing the 40-mesh sieve and the percentage of 100-penetration residue in the treating oil. These limits have been set in an attempt to bracket the optimum quantity, or in other words to obtain some sections too lean and some too rich in order to obtain the maximum of information.

To a number of sections varying quantities of aggregate were added prior to scarification so as to test the efficiency of additional friction material in case too great a degree of plasticity was induced, and also to check the relative efficiency from an economical viewpoint. The range of percentages of the material passing the 40-mesh sieve on the completed sections were about 20 to 30 per cent, 50 to 60 per cent and 100 per cent.

It seems to take about two or three weeks for the oil to permeate the mass the final stage of diffusion seeming often to follow a rain.

It is apparent in our opinion that the final result is a base and not a surface but it is hoped that the base obtained will require only a light armor-coat as a surface, the resulting combination, if successful, being obtained at a considerably reduced cost as compared to other types of low-cost construction in our state, in areas where natural aggregates are not readily available.

The project was constructed in the late fall during a rainy season and under conditions which were considered as distinctly unfavorable. Some sections, particularly those having little or no granular material, did not have a complete drying action such as would

be necessary for the very best results.

The lateness of the season prevented application of trial sections of surface and consequently the base was exposed to traffic throughout the following winter without surface protection. While exposed, the base carried traffic throughout its entire length. The soil type is predominantly a silt with a few stretches of clay at low points in the grade line.

Traveling plant-mix method

Since we were not certain of the success of the suboiling method, we tried, in Lewis county as a check, a second method in which we scarified the surface, windrowed the material and mixed it with the desired percentage of bituminous material and water by means of a traveling plant. This method is referred to as the mixing method.

The variations tried with the first method, including added granular material, were approximated under this method but at an increased cost. The advantages hoped for in the second method were greater uniformity, better mixing and better control.

Only about six miles of the contemplated ten miles of test sections were completed before winter weather caused a shutdown, but sufficient sections were constructed to give an interesting comparison after the effects of traffic and weather during the winter season were observed.

The remarks regarding weather conditions on the suboiling experiment also apply to this test. Due to the use of a pug mixer, it was necessary to add about 35 gal. of water per cubic yard of mixed material to obtain a dischargeable mix. This added water does not immediately leave the mix and a number of sections were not sufficiently dried to permit traffic prior

FIG. 1—SUBOILING OPERATION in which one-half of the road is receiving oil treatment as the initial step. The outfit consists of a tractor-hauled oil applicator served by a tank truck that follows.

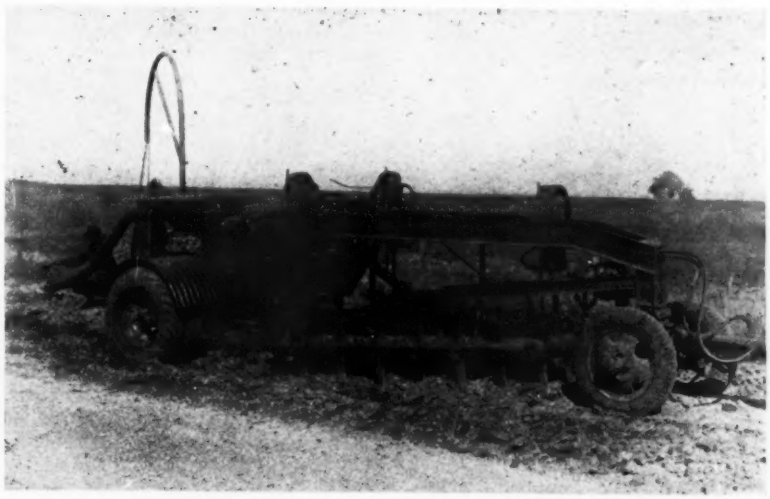
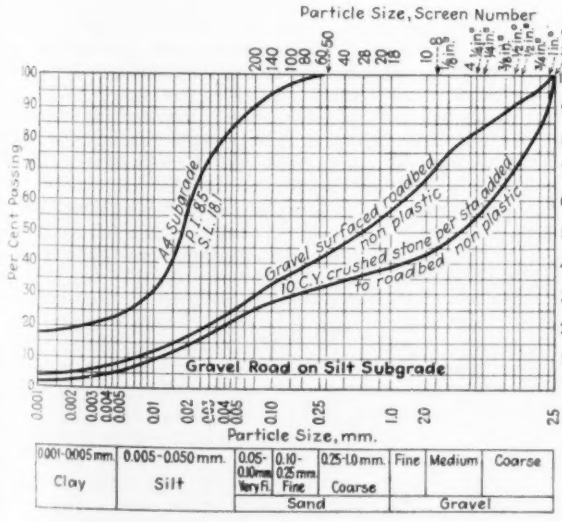
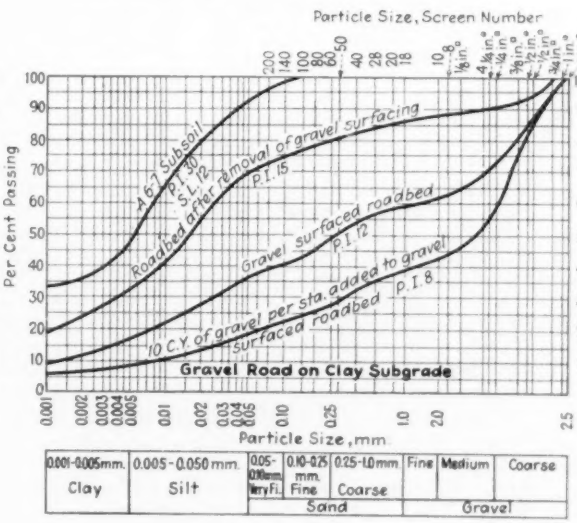


FIG. 2—THE OIL APPLICATOR forces oil through hollow teeth into the soil at a depth of several inches below the surface.

FIG. 3—CHARACTER AND GRADATION of materials treated in oil-stabilized base experiments of the Missouri state highway department.





TYPICAL BITUMINOUS MATERIAL USED IN OIL-STABILIZED BASE TRIAL ROADS IN MISSOURI

Cutbacks	SC-2	SC-3
Percent water	Trace	Trace
Specific gravity (60/60 Deg. F.)	1.0286	1.0691
Furol viscosity, Sec. at 122 Deg. F.	159	....
Furol viscosity, Sec. at 140 Deg. F.	....	201
Percent residue of 90 Pen.	60.0	....
Percent residue of 92 Pen.	....	78.2
Ductility of residue at 77 Deg. F.	145	130
Flash point, degrees F. (Cleveland open cup)	340 Deg. F	255 Deg. F
Percent loss on heating (50 gm. 5 hr. 325 Deg. F.)	5.84	8.07
Percent soluble in carbon tetrachloride	99.89	99.89
Cutbacks	**MC-3**	**MC-4**
Specific gravity (60/60 Deg. F.)	0.9647	.9747
Flash point (Cleveland open cup)	170 Deg. F	190 Deg. F
Furol viscosity, secs. at 140 Deg. F.	385	721
Distillation by volume:		
Initial boiling point	450 Deg. F	452 Deg. F
Percent off at 437 Deg. F.	0.0	0.0
Percent off at 500 Deg. F.	5.0	3.0
Percent off at 600 Deg. F.	15.5	11.5
Percent off at 680 Deg. F.	19.5	15.5
Tests on residue		
Pen. (77 Deg. F, 100 gm. 5 sec.)	136	141
Ductility at 77 Deg. F.	108	150+
Ducility at 39.2 Deg. F.	9	10
Percent soluble in CCl_4	99.80	99.85
Heterogeneity Test	No spot	No spot

Emulsions	No. 1	No. 2	No. 3
Percent demulsibility (35 cc. of .02 N.$CaCl_2$)	1.8	0.0	94.9
Percent demulsibility (50 cc. of 0.1 N.$CaCl_2$)	0.7	93.5	95.5
Distillation			
Percent water	44.0	48.5	46.0
Percent asphalt residue	55.8	48.0	49.0
Percent oils and loss	0.2	3.5	5.0
Tests on Residue			
Distillation			
Specific gravity (25/25 Deg. C.)	1.0443	1.0041	.9848
Penetration (25 Deg. C, 100 gr. 5 sec.)	129	300+	300+
Ductility at 25 Deg. C.	43	21	43
Total bitumen (Sol. in CS_2)	98.41	99.72	98.90
Percent ash	0.56	0.02	0.18
Float test at 50 Deg. C.	....	*	167

* Could not be obtained due to skin forming on surface of specimen.

to freezing and accordingly were not spread until the following spring.

Sections which had a longer drying time carried traffic with little or no signs of distress. There was evidence, however, of a sponginess or rubbery action indicating that future additional consolidation should take place.

Indications from experiments

The field test sections constructed during 1935 consisted of rather short sections due to the numerous variations of conditions tried. These sections gave promising indications and permitted the elimination of a number of sets of conditions.

The costs of construction were higher because of numerous changes and delays, and in order to develop further the possibilities a number of contracts were let during the 1936 construction season to try out the two methods under actual contract conditions. These projects have been largely completed as to base but will not be covered with armor coat until the spring of 1937.

The work during this season (1936) was constructed in general under the methods followed on the shorter sections and the treating materials were essentially the same except that, in addition to the use of SC and MC materials, some bituminous fluxes were emulsified and one car of TC 2 tar was used in connection with the suboiling method.

All of the work discussed is considered as current research and therefore care should be taken to avoid final conclusions. There are however certain indications that may be stated for the benefit of those who might desire to include similar projects in their programs; they are as follows:

1. There is a fairly definite range in amount of bituminous material optimum for use with the types of soils tried and the material used. (6 to 10 per cent based on soil fines passing the 40-mesh sieve). Definite failures occur consistently due to plasticity induced by excessive amounts of treating agent.

2. With the soil types encountered, emulsions diffuse more completely, uniformly and rapidly in the case of the suboiling method.

3. Emulsification is not necessary in the case of the mixing method, complete diffusion being obtained in all cases by the pug mill mixer used. The presence of fines in the mix promotes the formation of a clay emulsion as indicated by the appearance and action of the material discharged by the pug mixer.

4. Treating agents such as cutbacks, having abrupt gaps in distillation range, tend to fractionate during the diffusion period when used with the suboiling method. It is believed that such fractionation tends to cause a slower and much less uniform diffusion.

5. No fractionation has been noted in the case of the use of emulsions.

6. Rescarification and blade mixing can be economically used to improve nonuniform and insufficient diffusion in the case of the suboiling method and may prove essential to the success of this method.

7. Some sections are under observation which have a considerable layer of untreated soil sandwiched between the suboiled lower layer and the prime and armor coats. This condition is not considered desirable but there are indications that such sections may prove serviceable.

8. Thickening of the edges of these bases is advisable and desirable. In the mixing method the subbase is immediately available for shaping to provide for tapering to a thickened edge. With present suboiling equipment, the maintaining of a uniform bitumen content in the treated material requires a uniform depth of treatment for the application of oil to the edges.

9. More accurate means of control of the bituminous material applied by the suboiling method is desirable. To obtain suitable accuracy at present it is necessary to add the treating agent in more than one increment.

10. Under the conditions used and at the present stage of development of both methods, the mixing method gives a more complete and uniform diffusion of the treating agent although at a higher cost of manipulation.

11. The presence of proper amounts of moisture is necessary or highly beneficial, both as an aid to proper coating of the particles and to insure a high degree of compaction. The addition of excessive moisture at the start of the treatment does not appear to be detrimental, assuming that compaction is continued through the drying range. However, where conditions are such that an excessive amount of water is trapped in the subbase, serious trouble may be experienced for some time due to subsoil weakness caused by abnormally high moisture content.

12. Mixtures containing as low as 50 per cent of aggregate retained on the 40-mesh are entirely stable and indications are that this percentage may be considerably reduced with further study. Sections containing no aggregate have been under service since 1935 and wherever proper amounts of treating agent were used no serious failures have been observed.

13. Percentages of aggregate may be varied to obtain economy dependent upon the relative costs of aggregate and bituminous material, since the addition of plus 40-mesh material permits a proportional decrease in oil.

14. Preliminary compaction must proceed from the bottom upwards. Multiple wheel rollers equipped with automobile or truck tires, and sheepfoot rollers seem to give satisfactory results when supplemented by use of the ordinary flat wheel roller for final compaction.

Bridging the Rio Choluteca with a Two-Span Suspension Structure

Pan-American Highway bridge in Honduras consists of two 330-ft. main spans and loaded backstay side spans of 110 ft.

By Conde B. McCullough *and* Raymond Archibald
U. S. Bureau of Public Roads, San Jose, Costa Rica

THE THREE BRIDGES *designed by the U. S. Bureau of Public Roads for the Pan-American Highway in Central America are all suspension structures, one of the controlling reasons for the selection of this type being its theoretical resistance to earthquakes. That the theory may be tested during the life of the bridges is suggested by the earthquake that devasted the town of San Vicente, El Salvador, on Dec.* 21. *Two hundred miles north of San Vicente is the site of the bridge over the Rio Tamasulapa, while two hundred miles south of San Vicente is the bridge over the Rio Choluteca described in this article. The third bridge is located near the southern end of the route in the Republic of Panama and crosses the Rio Chiriqui. Its design was described in ENR, Nov.* 26, 1936, *p.* 767. —EDITOR.

THE SECOND of the three bridges to be placed under construction in the international cooperative program of building the Carretera Inter-Americana crosses the Rio Choluteca in Southern Honduras. Like the other bridges, it is of suspension type but in an unusual double span layout with two main spans of 330 ft. and side spans of loaded backstay type 110 ft. long. The total length of bridge is 984 ft.

Rio Choluteca has a rather extensive watershed in an intensive rainfall area —100 to 125 in. during the wet season from May to November. The river is fed by numerous large tributaries which render it quite temperamental. Sudden stage rises, amounting to as much as two meters, frequently occur without warning even during comparatively dry periods, and in flood the river is swollen to a width of nearly a kilometer with a stage rise of 20 ft. and a flood current over 10 miles per hour carrying heavy drift.

Under circumstances such as these it was obviously impossible to hold falsework in the channel, except at prohibitive expense, and largely for this reason the suspension type was chosen. In addition, however, transportation from the nearest port (Amapala, Honduras), involves some rather difficult problems and the fact that the suspension span members lent themselves to shipment in small, relatively light units was also a controlling factor. The further fact that the suspension bridge transmits its load through a flexible elastic tension system thus rendering it particularly resistant to seismic stresses and the fact that this type has its center of gravity located well below the level of its supports also militated in favor of its selection.

The particular span arrangement selected was chosen after considerable study because a single 660 ft. span would have involved greatly increased cost while a shorter single span (450 ft. for example) would have involved either the selection of exceptionally long backstays or the placement of the north anchorage in the stream where it would be objectionable because of drift. It was highly desirable moreover to place the south pier at its present location to cut down cofferdam costs. Finally converting the present two-span arrangement into a single span would have necessitated the employment of a long south backstay, most of which would have been over dry land.

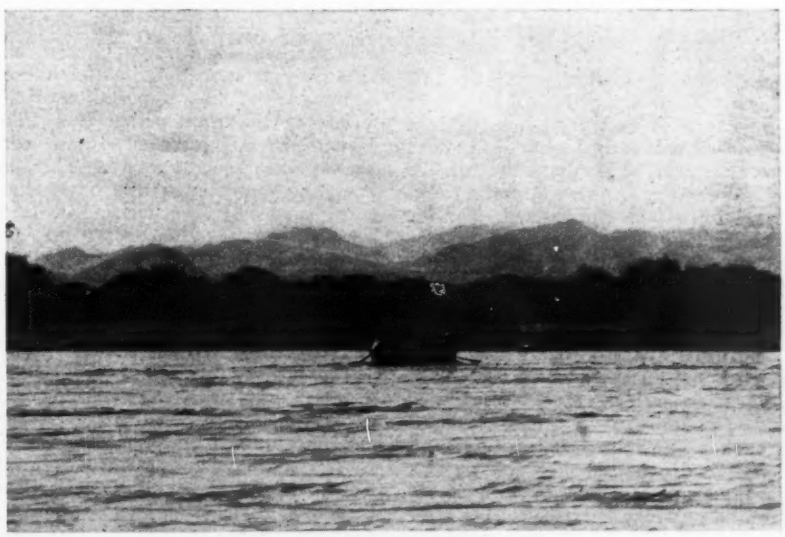
The arrangement indicated in the accompanying illustration was therefore chosen. It is unique in that it dispenses entirely with the use of live load stay cables through the employment of an unusually deep stiffening truss. The center tower has been braced by means of radial stay cables as a matter of additional rigidity. However, the stiffening truss, which is continuous through the center tower, is sufficiently rigid in itself to eliminate excessive deflection under unbalanced loadings.

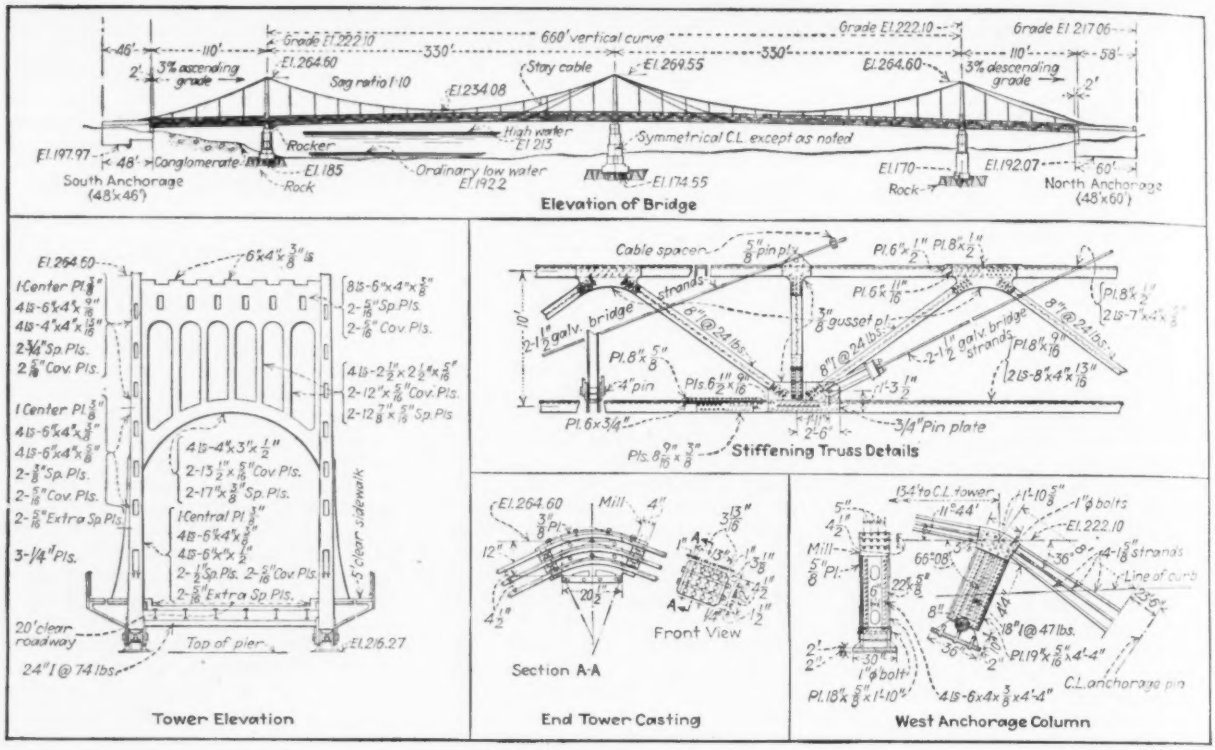
Details of design

The design provides a 20-ft. clear roadway and a 5 ft. concrete walkway on the outside of each truss which will be paved with asphalt plank to render it suitable for equestrian as well as pedestrian traffic. The south anchorage is of mass concrete, the north anchorage of cellular construction filled with gravel. Both anchorages, as well as all piers, are faced with cut stone. This facing stone is a fine textured volcanic Tufa obtained from a quarry located about 3 kilometers north of the site. It is of pleasing texture and beautifully colored from pink to gray. It works easily under the hammer and is being quarried, as needed, by the plug-and-feather system without the use of explosives. The quarry is located on a side road impassable for automobiles, and the stone is being transported to the north bank of the river in ox carts. That portion which is needed for the south pier and anchorage is transported across the river in dugout canoes.

Ordinarily work of this type would be somewhat expensive, but in view of the low labor wage scales locally prevailing it has been possible to place this cut stone at a cost per cubic yard not greatly exceeding that of concrete, especially when consideration is given to the

SITE of the Rio Choluteca Bridge in Honduras. The dugout canoes are used to transport men, materials and equipment across the river.





TWO-SPAN suspension bridge details for structure being built on Pan-American Highway in Honduras.

fact that the masonry facing serves also as form work for the interior mass. The average size of the stone employed is 16x12x12-in.,— a volume of 1.33 cu.ft. per stone. The average unit costs per stone (in lempiras) to date are as follows: Cost at quarry 0.50L; transportation to river 0.16L; transportation across river in dugout canoes 0.03L; transportation from east bank to material yard 0.03L; cutting and finishing stone 1.24L. Total cost of finished stone 1.96L. Cost of laying stone 0.28L. Total cost per stone in place 2.24L. Total cost per cubic foot in place 1.68L. Total cost per cubic yard 45.36L.

At the present rate of exchange a Lempira is worth $.50 gold, which makes the cost of the cut stonework in place $22.68 per cubic yard. This cost is exclusive of mortar which amounts to about $2.00 per cu.yd.

The type of masonry employed is a rock-faced ashlar laid with ¼-in. flush mortar joints. For the sides of the anchorages the finish is a medium texture, with a ⅛-in. chisel draft. For the pilasters and piers a coarser texture employing a ¼-in. chisel draft is employed. The balustrade will be of pressed stone.

In the design of piers and anchorages a Spanish Colonial motif has been selected, and the steel towers have been designed in harmony therewith. Closed box sections have been employed throughout, and the portal arrangement comprehends the employment of Romanesque arches and a castellated top strut, all of which is typical of the early Spanish Colonial.

The stiffening truss is 10 ft. deep and continuous through the center tower. Silicon steel has been employed for the majority of the truss members and for the floor system. The chords are of the U-type, and the diagonal system of I-beams, eliminating entirely lace bars and battens.

Administration

Under the existing cooperative arrangement for these bridges, the United States government, through the U. S. Bureau of Public Roads, prepares all plans and specifications, supervises all construction, furnishes all steel and other fabricated material, all mechanical equipment and all transportation of materials to the construction site. The United States government also constructs the superstructure. The cooperating Republic, on the other hand, furnishes all local materials, all labor for their transportation to the site, and all labor for the construction of foundations and substructures and grading of approaches. The cooperating Republic also furnishes all needed rights-of-way and easements.

The projects are under the general direction of Thomas H. MacDonald, chief, U. S. Bureau of Public Roads, and under the immediate direction of E. W. James, chief, division of highway transport. The United States Steel Products Co. has the superstructure contract, while the substructure is being built by day labor method by the government of Honduras under the direction of Sr. Don Alfredo Membreno, chief of highways for whom Alonzo Valenzuela and Lisandro Suares are resident engineers. T. M. Whedbee and Simeon Martinez are resident construction engineers for the U. S. Bureau of Public Roads. Srs. Colindras and Romero are construction superintendents.

Private Water Supplies in Memphis

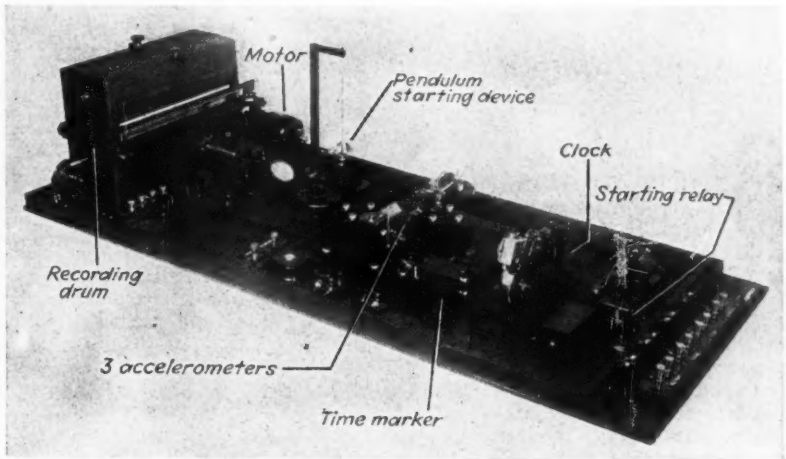
THERE ARE more than 150 privately owned and operated well water supplies in Memphis, furnishing drinking water to more than 50,000 people daily and water for industrial use in office buildings, hotels and plants, according to the *Monthly Health Bulletin* issued by that city. In all, these private sources supply more water daily than the two city pumping stations combined.

The wells are constructed according to specifications issued by the city and are inspected each month. In addition, an annual survey is made covering the entire private system. Some of the wells are cross-connected with the city supply but check valves and other safety devices have been installed as safeguards against possible contamination.

Seismic Survey Program Extended Into Montana

Strong motion accelerographs of improved design are added to the large group of recording instruments installed in California by the Coast & Geodetic Survey

FOUR strong-motion accelerographs were installed recently in Montana as part of the seismic survey program of the U. S. Coast & Geodetic Survey. The instruments were placed in Butte, Bozeman, Helena and Missoula. With the two sensitive seismographs maintained by the Coast & Geodetic Survey at Butte and Bozeman, facilities for reporting seismic shocks now are such as to give very comprehensive information on the nature of earth movements in Montana. Current interest in earthquakes and in earthquake-resistant construction in Montana dates from the very severe shocks in Helena in October, 1935 (*ENR*, Oct. 24, and Nov. 7, 1935, pages 588, 653). Earthquakes previously had occurred in the Three Forks, Mont., area (1925).



LATEST DESIGN of device for recording heavy earthquake shocks.

Records on wider paper

The instruments, which are different in several important features from previous models, are of the type shown in the accompanying picture. In this view the outer case of the instrument has been removed. This type is known as the 12-in. accelerograph because record paper 12 in. wide is used on the recording drum instead of the narrower widths used in earlier models; some models recorded on paper only 6 in. wide. The essential function of the instrument is to make three records on sensitized paper mounted on a drum, which is housed in the lightproof case at the extreme left of the assembly. Each record indicates the extent of earth movement in a different plane. By using record paper 12 in. wide, the width of record in each of the three planes can be as much as 4 in. without overlapping. The record is made by a pin point of light whose fluctuations are controlled by the three accelerometers, one for each plane, mounted in the center of the panel assembly.

Unlike the seismograph, an instrument of this type is not operative until a shock occurs heavy enough to jolt it into action. Motive power for actuating the moving parts comes from two 6-volt batteries. This feature is provided so failure of the electrical power supply from outside sources will not put the instrument out of operation. However, the batteries are provided with a charging device supplied by the commercial power source, thus minimizing the inspection attention required to keep the instrument in continuous operating condition.

The panel size is 20x48 in., and on it are mounted all parts of the equipment except the d.c. power source, already mentioned, and a signal device, to be mounted at any convenient point, whose function is to indicate whether the instrument is operating.

The recent Montana installations are an extension of the seismic survey program which was begun in California by the Coast & Geodetic Survey in 1932. The field work is under the direction of F. P. Ulrich, chief, seismological field survey of the Coast & Geodetic Survey. At present, in addition to the Montana instruments there are 51 accelerographs under Mr. Ulrich's supervision in California, scattered over the state from Eureka to San Diego. A large number of them have been placed in the more populous areas, notably in Los Angeles and San Francisco, but their distribution is such as to give records from various locations and on structures of different types. For example, vibration tests were made on Morris Dam, a concrete gravity structure near Pasadena; and in some of the taller modern buildings the practice has been to put an instrument in the basement and another on or near the top floor, to obtain records at high and low elevations for comparison.

The need for accurate data in engineering seismology was recognized by the late John R. Freeman, who took the initiative in securing an appropriation from Congress for purchasing, designing and installing instruments for recording data of this sort under direction of the U. S. Coast & Geodetic Survey. Instruments are installed where it is felt that the most valuable results can be obtained. Articles on use of strong motion accelerographs in the seismic survey program and on the data obtained have been published in *Engineering News-Record* as follows: Sept. 8, 1932, p. 288; April 6, 1932, p. 442; June 22, 1933, p. 804; March 8, 1934, p. 315; Nov. 14, 1935, p. 680.

A.A.E. Requests Conference On Engineering Titles

The American Association of Engineers has transmitted to President Roosevelt a group of resolutions adopted by the national board of directors at its annual meeting in November requesting that the Bureau of Labor Statistics or some branch of the U. S. Department of Commerce call and sponsor a conference of the professional engineers and the non-professional operating and stationary engineers in order to work out a terminology satisfactory to both groups which would distinguish between the members of the two groups.

Another resolution transmitted at the same time states that it is now the practice of some agencies of the federal government to give the title of engineer to men not performing work of professional rank, and that this practice is exerting a detrimental effect on the engineering profession.

The association states that the loose language of professional engineering license laws and of license laws for stationary and operating engineers is causing unnecessary confusion and is doing harm to the members of both groups.

Keeping Snow Off the Road At Little Cost

Ingenious job-devised equipment spread a normal snow-removal fund wide enough to cover last winter's blizzards

By B. H. Frasch

Division Engineer, Ohio Highway Department, Zanesville, Ohio

OHIO, like other states not located in regions where heavy snowfalls are an every winter occurrence, was hard hit by blizzard and excessive ice in the winter of 1935-36. During the several previous years back to 1929, winter highway maintenance had presented no particular problems and it had been a relatively simple matter to keep the roads clear of snow and free from ice. Motorists had become accustomed to this kind of service and the department of highways had become accustomed to giving it.

When the winter of 1935-36 came along with its prolonged sub-zero temperatures, heavy snows and driving sleet, users of the highways didn't garage their cars, remove the batteries and drain the radiators to await more agreeable weather, but filled the radiator with anti-freeze, turned on the windshield defroster and car heater, got behind the wheel and started out. They expected that the roads would be open and reasonably safe, and if not they were prepared to kick about it. Here, then was the problem confronting Ohio highway officials: To give the same service under extremely severe weather conditions that the public had been accustomed to receive during previous mild winters.

Of course, with unlimited money to spend the problem would have been quite easily solved by the immediate purchase of needed equipment and the employment of additional men. But Ohio is not one of those rare states in which gasoline-tax revenue serves the needs for which it is intended; much of it is diverted for schools, flood and drought relief and sundry purposes. Consequently the roads receive far from the full benefit of the money they earn in taxes, and highway officials must exercise considerable ingenuity to make the available funds perform financial acrobatics. How one maintenance division did it is told here.

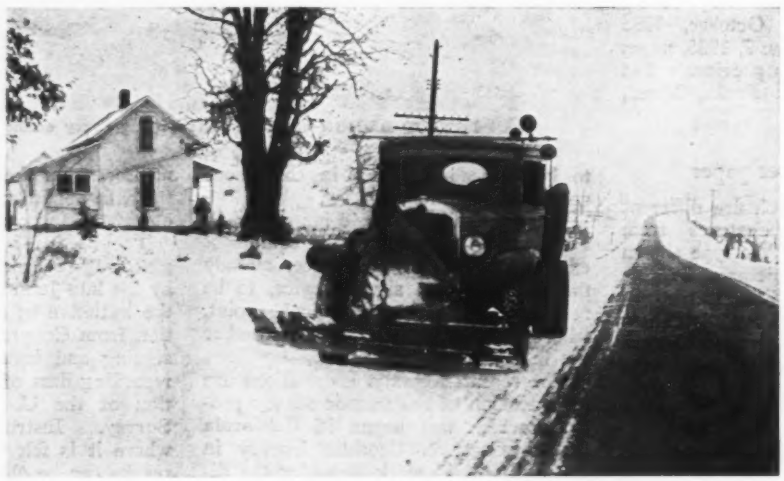


FIG. 1—SHORTAGE OF EQUIPMENT to handle 1935-36 blizzard snowfall was supplied by maintenance shop construction of 35 small plows at a cost of $50 each.

The problem

The division considered (No. 5) embraces seven counties in the central eastern portion of the state and includes about 1,200 miles of roads, ranging from traffic-bound to rigid types. There is rugged hill country in the east and flat lands in the west; traversing them from east to west, for 80 miles is the National Highway, one of the heaviest traveled roads in the state.

When last winter's conditions arose, it was obvious that not nearly enough men, money or equipment were available to take care of the extra work. The only solution was in some way to improve the present methods of winter maintenance to meet the needs.

The first need was a better way of keeping the roads clear of snow and the second, a more satisfactory means to skidproof highways promptly on which ice had formed. Accomplishment of the former was necessary to make motor travel possible and of the latter to make it safe.

The available snow-fighting equipment included a number of plows of medium and large sizes, sufficient to satisfy the requirements of the usual Ohio winter but inadequate to conquer the heavy snowfalls encountered last year. It was decided, under the circumstances, that the best service could be rendered by using small plows to patrol the highways constantly during storms and remove the snow fast enough to prevent the formation of too great drifts.

Small plows built

Lacking funds to purchase the number of small plows required, the division officials devised one that could be produced in the division's own shop for about $50 and could be used on all of the small trucks. Thirty-five such plows (Fig. 1) were built.

All plows—small, medium and large—operate from the seven county garages (one in each county) and from other strategic locations. As soon as snow starts falling in any locality, the small plows are placed in service on the highways and the patrolling begins. All men are subject to call day or night and are required to be on the job within

one hour after the start of snow. When the snow gets too great a start for the small plows to be effective, the larger plows are used. Often the larger plows are followed by the small ones to remove the snow left in the wake of the large plows. Although there were times last winter when the division was almost completely snowed under, this procedure generally kept the roads open to traffic.

Ice-control service

While snow removal is the first consideration in winter maintenance, the control of ice is of equal importance and, if neglected, brings even graver consequences. If roads are blocked by snow, it is an inconvenience rather than a danger, but when they are open to traffic with icy surfaces, they present a real hazard to motorists.

To provide ice-control service, it was evident that the workers must cover the district faster, and this meant a speedier method of obtaining abrasive materials, a speedier method of applying them to road surfaces and a wider distribution of available man power.

Again mother necessity came to the fore, and division authorities conceived the idea of large-capacity storage bins for cinders or sand, designed so as to facilitate quick bin filling and just as quick loading of trucks. The division now has seven of these bins located at strategic spots in the most congested areas and more are scheduled to be built. They were constructed at an average cost of $750 including all material and labor.

The bins were erected where relocations have been made on lower levels than the original roads, since in this way they can be built against a 25 to 30 ft. slope and advantage can be taken of the old roadway for delivering the materials. Trucks delivering the abrasive materials use the old roadway for access to the bin and are able to dump the materials directly into the hoppers.

The bins are 32 ft. long and of wood construction (Fig. 2). Timbers of 10x10 in. and 5x10 in. sizes are used for framing and planks 2 in. thick have been found suitable for sheeting. The bins have a capacity of 120 cu.yd. and, of course, additional material can be stockpiled nearby and pushed or shovelled into the bin when replenishments are needed.

As the abrasive materials are delivered to the bins, they are treated with calcium chloride at the rate of 75 lb. per cu.yd. The chemical retains its ice-melting properties during the time the sand or cinders are in storage, without impairing its effectiveness when the materials are spread on the road. Therefore, it performs the double purpose of preventing the materials from freezing in the bins and of enabling the grits to anchor themselves securely when applied to the icy surfaces.

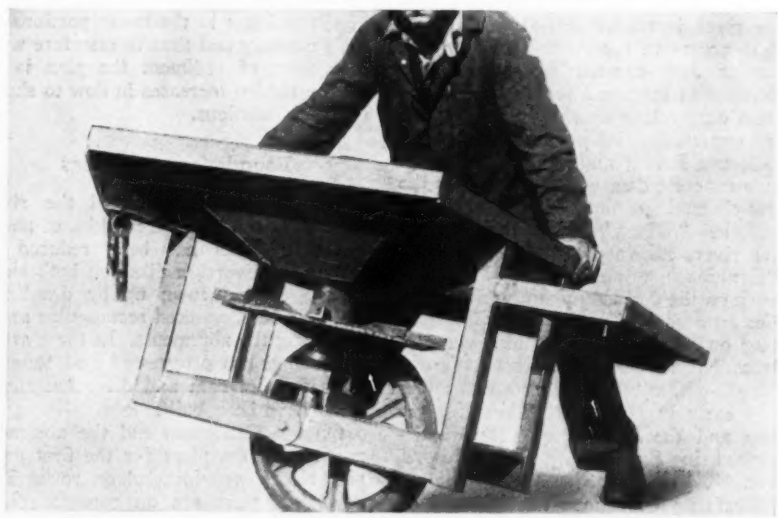
FIG. 2—BINS for treated ice-control abrasives reduced the labor and time required for loading trucks.

Under the former method of handling ice-control materials, stockpiles of treated sand or cinders were placed here and there along the highways for use as occasion arose. When icy conditions developed, trucks drove to the nearest stockpile where they were loaded by hand shoveling by four men and the truck driver. Now, the trucks merely drive under the bin, one man controls the chuting of the treated materials (which are fed by gravity from the top of the bin), and the trucks are loaded and on their way within two to four minutes. Of course, it is still necessary to maintain stockpiled material on roads not served by the bins but the plan is to continue the construction of bins to service the entire division. It is found that a bin can serve all roads within an 8 to 10 mile radius.

With both the time and the number of men required to obtain and load the ice-control materials substantially reduced, the next task was to speed up the spreading methods and make it possible for the fixed crew of men to cover the division effectively. The success in devising the small snow plows led the shop to try a hand at building a sand and cinder spreader. In the light of past experience, it was certain that the spreader should be simple in operation and of rugged construction. After a little experimentation, the shop produced at a cost of about $50, a unit (Fig. 3) that has proved exceptionally efficient and practically fool-proof in operation.

The spreader consists essentially of a hopper 30 in. square, a spinner disk 18 in. in diameter, a drive wheel 16 in. in diameter, and a platform and hand rail for the operator, all built around a frame constructed of angle and channel irons joined together by electrical welding. A standard hitch is used so the spreader can be attached to any truck,

FIG. 3—MECHANICAL SPREADERS for trucks hauling abrasives were constructed in maintenance shops at a cost of about $50 each.



and the flow of treated sand or cinders into the hopper is regulated by the discharge gate on the truck. The materials drop from the hopper onto the spinner disk, which rotates by the friction of the drive wheel. Tension is maintained by a compression spring. The range of spread is from 12 to 30 ft. and is governed by truck speed and by adjusting the drive wheel in or out on the spinner disk. This double adjustment feature makes it possible to operate the trucks at practically any speed, even up to 40 or 45 miles per hour. Last year, solid tires were used on the wheels of the spreaders, but they are being replaced this year by pneumatic tires.

The uniform distribution of sand or cinders accomplished with the spreaders results in a considerable saving of materials, as the same amount of abrasives will now cover over three times the area possible by hand spreading. Even a light application produces a sandpaper-like surface, since the abrasives, treated with calcium chloride, melt themselves into the ice or anchor there, resisting dislodgement by wind or traffic. The spreading operation in no way prevents the use of a plow on the front of a track and often a small plow is used in this way, to remove loose snow from the icy surface and thus allow the treated grits to embed themselves and become effective more rapidly.

Equally as important as the saving in material is the saving in man power effected by the spreaders. Five men are needed to attain any speed at all in hand spreading but with the spreader only the man is required to control the feed of materials from the truck into the spreader. Since one man can also take care of the loading of trucks from the storage bins the division has been able to spread the available man power just as far as is believed to be possible. With the combination of bins and spreaders, a truck can drive from the garage to bin, get its load and then spread the abrasives in just about the length of time usually required to drive to a stockpile and load the material by hand shoveling.

Conclusion

Division No. 5 does not set up its system of winter maintenance as the acme of perfection, and this article is written primarily to relate how it met and overcame what to it were extremely serious problems last winter. However, it is hoped that the report of experiences and activities may offer suggestions to other members of the highway fraternity confronted by similar problems.

Authorities of Division No. 5 include B. H. Frasch, division engineer; P. K. Troutman, assistant division engineer on construction and C. B. Shaw, assistant division engineer on maintenance.

Progress at Imperial Dam

Dikes and well points protect foundation work—Concreting at California end well advanced—Diversion via Arizona side planned for this year—Very large silt handling plant

CONCRETE placement, in progress on both sides of the Colorado River at Imperial Dam site, is building up a structure that is advancing from both abutments toward the river channel. Present plans are to make diversion of the stream flow early in the summer of 1937, after which that portion of the dam across mid-channel will be completed. Work at the dam site began with the construction of dikes around the area to be occupied by the California end of the structure. A pile trestle across the river just upstream from the dam gave access to the Arizona side where similar dike construction was begun. Because of storage afforded by Boulder Dam only relatively short flood periods are expected, principally from the Bill Williams River; and, since the hollow-type concrete dam which constitutes the mid-channel portion of the structure will be "floated" upon the bed of the river, no very great construction difficulties are anticipated. Meantime work on the desilting plant, which occupies an area 1,000 ft. wide by 3,000 ft. long on the California bank, had progressed to a point where installation of the silt-gathering mechanism was under way early in December. Plans for the dam and the desilting plant were described in *Engineering News-Record*, Oct. 17, 1935, p. 538.

Desilting operations are planned on the basis of removing all heavy sediment from a constant flow of 15,155 sec.-ft., the full capacity of the All-American Canal. From this flow the silt will be gathered and discharged into the sluiceway, an artificial channel passing the desilting plant. This sluiceway will carry the entire waste flow of the river at Imperial Dam except in flood periods, when there also will be discharge over the weir section of the dam. The capacity of the sluiceway is 25,000 sec.-ft.; only flood flows will pass over the weir. Should there be any tendency of silt to lodge in the lower portions of the sluiceway and thus to interfere with movement of sediment the plan is to release sudden increases in flow to sluice out accumulations.

Foundation conditions

When work was started the river channel at the site had a width of about 1,200 ft. This has been reduced to 800 ft. by diversion dikes on both sides of the river thrown up by draglines, which have unwatered rectangular areas adjoining the abutments. In these areas excavation has progressed and foundations for the dam and diversion structures have been built.

On the California end the abutment and one of the piers for the first gate, pier No. 1, are founded on rock. The adjoining piers are on concrete piles, as is the intake of the sluiceway beyond. The piles for the most part are 50 ft. long, driven on 3:1 batter. Successive rows are battered up and downstream alternately. They extend down to a gravel layer in the streambed. The weir section of the dam, 1,200 ft. long, will rest on the silt riverbed after preparation by rolling. It will have a maximum height of 31 ft. and will be partly filled with sand and gravel ballast for added weight. A long upstream and downstream concrete pavement with sheetpiling cutoff walls will be used to cut off flow in the streambed beneath this portion of the structure.

On the Arizona side piles are used to support the non-overflow portion of the dam just inshore from the weir section as well as the first of the adjoining gateways for the Gila Valley canal. From this point inshore the remainder of the Arizona intake structures rest upon material so solid that piles were not required. Groin walls are used on the overflow weir to prevent scour upstream, and riprap will be applied generously to the exposed slopes.

It is notable that in the complete structure five types of piles are used, namely, steel sheetpiles, concrete bearing piles, wood bearing piles, concrete sheetpiling and wood Wakefield piling. Concrete piles of both types were cast on the river bank along the desilting

basin, a location convenient for delivery to the dam site.

To an unusual degree well points are employed on this foundation work because the nature of the material is such that well points are ideally suited to controlling dike slopes. The Colorado River silt at this dam site, when wet, does not stand in embankments; the angle of repose may be as low as 10:1. With well points in operation, moisture is drawn out of the material to such an extent that cohesion becomes effective and as a result almost vertical slopes may be used. In fact, some of the excavation carried out in the form of successive widening of trenches made use of slopes that were very nearly vertical, as shown in Fig. 4.

As many as 2,800 well points are in operation some of the time. All of these are 2-in. pipes with double screened intakes. The length ranges up to 24 ft. Ordinarily about 45 well points are operated by a single pump through a 6-in. header. The average pumping head ranges up to 15 or 20 ft. The pumps used are self-priming, a highly necessary feature because when any particular part of the system reduces the water table to well point level and thereafter draws in air, the pump design must be such that inflowing air will not break the seal and interfere with suction from the other well points. Some of the pumps are operated by gasoline engines and others by electric motors. This type of unwatering is used almost exclusively on the job and complete dependence is placed upon it. The only time when one of the pits was nearly lost was on the occasion of a 20-min. power shutoff which stopped all electric pumps serving well points.

Diversion program

In constructing the two easterly canal gates of the Gila Valley canal intake, the paving in the bottom was placed

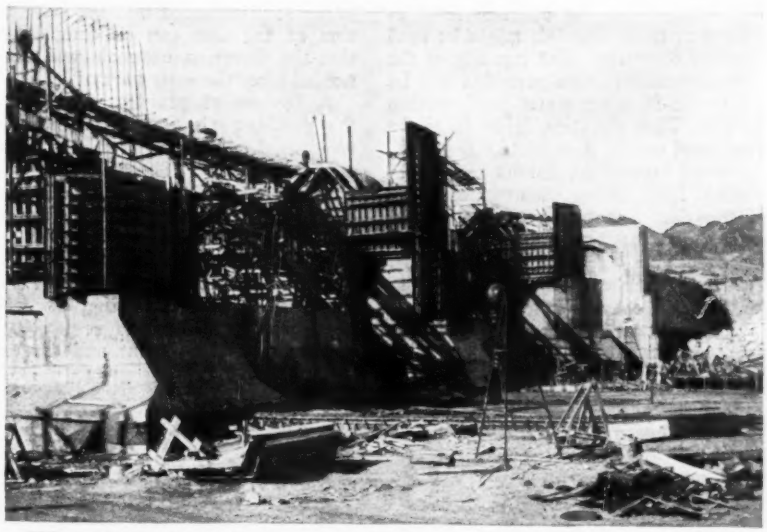


FIG. 1—IMPERIAL DAM from the upstream side at the California end. Parts of all four of the channels that will be controlled by 75-ft. roller gates are shown. California abutment at extreme right. The foreground area, which is below river level, is protected by earth dikes.

FIG. 2—TYPICAL INSTALLATION of well points near California abutment. Note close spacing of 2-in. pipes (about 3 ft.). Second stage well points are at a lower level.

FIG. 3—THE MAIN CANAL and other water channels connecting with the desilting basin are paved with heavy riprap 18 in. thick.

FIG. 4—TWO-STAGE well point operation. The second system was needed to maintain the stability of the earth bank below the first stage.

6 ft. lower than the ultimate level in order that these channels might be used for river diversion. The capacity of the diversion channel thus provided will be 65,000 sec.-ft. when water level reaches El. 170. That elevation is 11 ft. above river level with a flow of 10,000 sec.-ft. and river bottom conditions as of November, 1936. After construction work on the dam has been completed, and while the streamflow is carried through the sluiceway on the California side, these two channels will be built up to the final or operating level.

The construction program contemplates diversion early in the summer of 1937. It is expected that the river portion of the dam can be completed so that the diversion channels will not be needed after the early part of 1938.

A feature of progress thus far on the desilting plant is the building of compacted embankments to form channels and basins. The earthfill slopes, after sprinkling and rolling has been completed, are finished off on the outside with a dumped rock blanket on a 3:1 slope. On the inner faces a heavy rock paving is placed by hand on a 2:1 slope. This special paving, of which there will be an area of some 200,000 sq.yd. in desilting plant and diversion channels on both sides of the river, is 18 in. thick. Preparation is made by first putting down a gravel base or ballast 6 to 8 in. thick in which the facing stones are set. The facing stones, which are required to be not less than 12 in. thick, are placed by hand and wedged in with spalls.

Imperial Dam and the desilting works were designed and are being constructed under the direction of the U. S. Bureau of Reclamation, R. F. Walter, chief engineer; R. B. Williams, construction engineer, at Yuma, Ariz.; John K. Rohrer is resident engineer in charge at the site.

Build Safe Roads!

American Road Builders Association dedicates itself to the principle of building safety into highways by improved design and construction

THROUGH the hundred committee reports and individual papers planned to cover all the diverse highway interests of its membership the American Road Builders Association in convention last week at New Orleans wove the doctrine of the safe road. Expressed primarily in the sessions of the committee on safe highways the thought was carried through the sessions on base stabilization, foundation drainage and diversion of road funds; all headed up in methods for building safety into roads and in expressing a definite purpose to hold on to the tax money required for safe construction.

The convention opened with a heavy registration which increased to several thousand before it closed. Welcome to the state was extended by A. P. Tugwell, state treasurer and to the city by Mayor R. S. Maestri. W. T. Chevalier, president of the association, reviewed briefly the highlights of the coming new era of public roads thinking and highway improvement. He was followed by Gibb Gilchrist speaking for the Association of State Highway Officials and R. H. Coombs, President of the National Rural Letter Carriers Association. Thos. H. MacDonald, Chief, Bureau of Public Roads, reviewed the year's outstanding highway accomplishments abroad and at home and pointed to new prospects and conditions confronting highway development of coming years.

Elections and resolutions

The election of officers resulted in the reelection of W. T. Chevalier as president; Jas. H. MacDonald as treasurer and Charles M. Upham as secretary. Mr. Upham was also reappointed engineering director. The new district vice-presidents elected are: Alexander Hancock, Mobile, Ala.; J. D. Manley, Leesburg, Fla.; W. A. Olen, Clintonville, Wis.; and H. G. Sours, Akron, O. J. A. Bromley, Annapolis, Md.; Frank J. McDevitt, St. Louis, Mo.; and Wm. M. Parish, Chicago, were elected vice-presidents at large.

At the session of the National Highway Advisory Council resolutions were passed urging increased federal aid, disapproving force-account construction and proposing that federal funds be made available for road rehabilitation.

Safe highways

Two sessions, heading up in the activities of the committee on safe highways, centered discussion on lighting, skid resistance, grade crossing elimination, alignment and grade, cross-sections and accident data. The distinctive character of the committee objectives indicated by these subjects was emphasized further in the report by the committee chairman H. E. Tabler. In general, he said, the campaign of the committee is directed to the removal of the hazards from the highway instead of centering attention on the conduct of the driver. While the agencies that are centering their efforts on the driver deserve full consideration, it is felt that highway safety is fundamentally an engineering problem. To quote directly, Mr. Tabler said: "By straightening and widening our roads, by separating lanes of traffic, by flattening curves, by reducing grades and by eliminating dangerous intersections and railroad crossings, we shall do away with faulty highway conditions as a contributing factor in motor-vehicle casualties."

As organized for action the committee is divided into an engineering and technical committee and a committee on public education. Under the first committee are six problem committees having direction of the six safety problems named above. The progress reports of these problem committee chairmen formed the discussion of the engineering and technical committee work as of the present date.

Summarizing the actual applications of the lighting on highways, M. A. Conner stated that encouraging progress had been made during 1936. The State Traffic Commission of Connecticut lighted dangerous intersections at Marlboro and at Salem Four Corners and announced plans for lighting 6 mi. of the Boston Post Road from the New York line to Stamford. New York led all states by installing 33 mi. of lighted road, the longest single section being 17 mi. outside of Schenectady. Ohio undertook a program of 48 mi. in isolated stretches, three of which were completed in 1936 and others of which are planned for this year. Minnesota lighted a road between Minneapolis and Excelsior and laid plans for 1 mi. of road near Bemidji. Three stretches of 1 mi. each and a number of intersections were lighted in Illinois, and California put lights on the San Francisco-Oakland Bay bridge.

Reviewing the various laboratory and road tests that have been made on the resistance of various road surfaces to skidding R. A. Moyer discussed the more important details of the design features and corrective measures to be adopted. These have practical value

which warrants more extended presentation and they will be published later as a separate article. R. B. Brooks as chairman of the problem committee on grade crossings summarized available statistics, most of them quite old, on numbers of grade crossings and progress in elimination and gave reports of practice on division of costs between railways and states for 42 states; the last survey is original with the committee and provides a valuable summary for reference.

In line and grade and roadway cross-section, the reports by R. Getty Browning and M. W. Torkelson overlapped somewhat. Mr. Browning gave a number of examples of location practice, six of which from Massachusetts were analyzed in detail to bring out elements of good and poor practice. These analyses will be given at more length in an article to be published soon. In his report Mr. Torkelson summarized general discussion in ten fundamental rules: (1) Alignment and profile shall minimize the difficulties of vehicle control even at high initial cost for grading. (2) Adequate vision shall be provided of vehicles and people on the road and entering the road. (3) Shoulders of traffic lane width shall be provided and surfaced with easy slopes away from shoulders. (4) A nonskid surface shall be provided. (5) Adequate and proper signs and signals shall be provided. (6) Provision shall be made for pedestrians. (7) Separated traffic-lane construction shall be encouraged. (9) In original design provision for expansion shall be made. (10) Bridges of adequate capacity and grade crossing removal are essential. These rules, said Mr. Torkelson, are fundamental, none of them can be fixed by standards, all must be applied with discretion.

Passing from engineering technique H. F. Hammond of the committee on accident data pointed out that its distinctive purpose, still to be carried out, would be: "To determine the types, locations, classes and causes of motor-vehicle accidents that can be directly or indirectly attributed to the highway."

Contractor's session

After spending most of a one-day session deploring the invasion of the contract field by day labor operations and WPA activities, some 60 members of the Contractor's Division wound up their meeting with discussions and plans for creating a contractor's cooperative insurance and bonding company. Frederick Hoitt, secretary of the New England Road Builders Association, led the attack against day labor with a report of the division's committee on Contract System vs. Day Labor. Other speakers throughout the day attacked the day labor operations. The discussion of a contractor's insurance company was started by F. E. Koontz, secretary of the Michigan Road Builders Association in outlining plans his group has made for organizing such a company. Sponsors of the plan claim that public agencies operating day labor work do not have to pay as high compensation insurance rates as do the contractors, thus putting contract work at a distinct financial disadvantage, and furthermore, the only relief from high insurance rates is the formation of a cooperative company.

Mr. Hoitt presented a sober analysis of the day-labor situation. He blamed politics for its popularity. Politicians, he declared, are able to place many of their constituents on the public payroll, often putting men to work on construction who are wholly unfit and unqualified for the work—workmen that contractors wouldn't have on the job. The result is a heavy waste of the taxpayers money, he maintains. In speaking for the worker himself—excluding the undesirables—Mr. Hoitt pointed out that the day labor system offered little in the way of advancement and promotion, for ability and skill are not recognized, nor does the system develop the required qualifications for advancement. The effect on the moral fiber of the men, the speaker declared, was demoralizing.

Mr. Hoitt advised contractors to be a little more cooperative with politicians in putting to work men requested by those in office. He said that in many cases certain qualified workmen might well be put to work without detriment to the job. The idea, he said, is partly to satisfy the politician and keep him from getting interested in the day-labor system.

The speaker declared WPA was the present-day menace to the contracting business, and this relief organization threatens to destroy private construction operators. The public is apathetic toward the waste of WPA operations, but Mr. Hoitt believes the layman could be educated to realize the expense and inefficiency of all day-labor work. His committee advocated several steps for the consideration of the contractor's division, including education by print and by radio, collective action by contractors and cooperation with public officials who are sincere in giving the public full value for its construction expenditures.

A strange note was sounded at the contractor meeting—a sympathetic leaning toward organized labor. Mr Hoitt first raised the question in declaring that if construction workers were more fully organized labor would exert a powerful influence in wiping out the force-account system. In a following paper, E. J. Rainey of S. J. Groves & Sons Co., Minneapolis, listed the advantages and disadvantages of organizing construction labor without committing himself for or against the idea. The division went on record as remaining neutral on the question of organized labor, but the fact that the question was discussed in open meeting by a group of contractors is of significance. Mr. Rainey pointed out that the organization of labor would help fight extension of the day labor system, would enable contractors to make definite wage agreements and thus establish known labor rates, and would help stabilize the labor market, especially in skilled trades. Wm. P. McDonald, president of the contractor's division, declared that it will be necessary to organize heavy construction labor in many localities to prevent the building trades from moving in and taking charge, with the inevitable result of applying high building rates to heavy work and thus increasing construction costs.

Leon L. Wheeless, chairman of the Unemployment Relief Commission of Mississippi, outlined the requirements of contractors in relation to the unemployment relief insurance and social security acts. Those present asked many questions about detail procedure in keeping records and complying with requirements, but the impression gained from the answers is that there remains much to be settled in the setting up of smooth-working plans for handling records. Apparently, as far as unemployment insurance records are concerned, most states will accept copies of payrolls in lieu of regulation reports, thus cutting considerably the clerical work involved. The contractors seemed confused as to the difference between the unemployment insurance and social security aspects of the act.

S. F. Beatty, president of the Austin-Western Co. spoke on the development of equipment as it affects labor. He pointed out that the increasing use of equipment raises the standards of labor directly employed on the job, has offered employment to at least three men indirectly for every one directly employed and has raised the quality of highway construction.

C. J. Sherlock and H. H. Houk of the Alabama highway department, and Chas. A. Long, contractor of Bessemer, Ala., spoke on the various relations of engineers, contractors and inspectors.

Gas tax diversion

The single session on gas-tax diversion was planned specifically to bring out information on the legislation or procedure by which the few states now free from diversion were enjoying that freedom. Reporting for the committee on diversion, Murray D. Van Wagoner pointed out that from $11,000,000 in 1925 the volume of yearly diversion has increased in ten years to $147,000,000 in 1935 and will reach $150,000,000 for 1936. In this period over $1,000,000,000 in road user taxes have been taken away from the highways. This subtraction, said Mr. Van Wagoner had been made in various ways: By direct appropriation for specific purposes as schools, old-age pensions, general welfare; by placing highway revenue in

the state general fund; by allotment to general policing of highways; by allotment to counties and cities without check accounting with the result that the money can be and often is spent for general purposes. It appeared that sentiment against these practices is being aroused but much more active local and national effort is needed.

In discussion C. D. Vail of Colorado and C. W. Brown of Missouri stated that their states are meeting the situation by going to the people for constitutional amendments that prevent diversion. In Minnesota, said J. T. Ellison, the original constitution provided that the state could never engage in works of internal improvement. An amendment in 1920 provided for a state highway system to be financed by a tax on motor vehicles. There was then no gasoline tax but such a tax was imposed in 1924 and at the same time the constitution was again amended to secure the money from this tax for the road fund. In succeeding years since 1924 various attempts have been made to secure changes in the fundamental law that would permit other allocations of road users taxes but none has met with success.

While in a manner of speaking, Minnesota has avoided diversion more by accident than by intent, since in 1924 diversion practically did not exist, Maine, according to L. D. Barrows, decided to set up defenses ahead of possible attack by diversionists. While there had never been an attempt at diversion Maine road users felt that diversion weather loomed on the horizon and by popular petition called on the legislature to prohibit it by statute. The statute was enacted in 1935 and approved by popular vote at the general election of 1936.

Speaking for Massachusetts, G. H. Delano outlined the acts providing for highway funds and for taking from these funds for other purposes since 1932. All these acts have been entirely within the state constitution. The total sum diverted, 1933-35 inclusive, is about $31,000,000. A movement now in progress to secure a constitutional amendment was described by R. K. Hale; this action has to be initiated by popular petition and the work of securing signers is now in hand.

County road problems

The two sessions of the county officials division were rather barren of papers on engineering practice and problems. One whole session was devoted to a discussion of rules and regulations governing the farm-to-market low-cost federal-aid highway construction. Other subjects of social character were: Why every county should take out county membership, by W. O. Washington; the value of membership in the county division, by J. C. McLean; county membership and public relations, by J. W. Mavity; reconciliation of county officials to the value of county planning, by C. D. Trump; influence of county planning on the promotion of health and social stability by H. R. Olson.

In a strong report the committee on county legislation finance and administration headed by A. M. Williams said: "Based on a study of the data collected, the committee recommends that as a first step in raising the standard of local road work, all highway administrative road units smaller than the county be eliminated and their road systems be absorbed into the county systems. As a second step in the beneficial modification of local highway administration, no less important than the elimination of the smaller-than-county units, is the consolidation of the roadwork of the smaller and poorer counties in such a manner that the advantages of modern management, methods and machinery are enjoyed while the principle of community control is not sacrificed."

The report on design and construction by L. G. Belknap and on maintenance by H. G. Sours were running summaries of current practice.

Stabilization and drainage

A group of ten papers and half a dozen supplementary discussions occupied two largely attended sessions on Tuesday, Jan. 12. H. F. Clemmer, as chairman of the sessions, described the present interest and activity in base stabilization experiments as having a broader cause than mere ambition of the technician for structural integrity and durability. Transport, he said, was demanding that not merely a few main roads but all roads should give all-weather service and a safe and substantial trackway for modern higher speeds. On the lower grade roads these demands could be met at costs that could be afforded by stabilizing the foundation and using a very light wearing surface.

Six papers on current methods of stabilization were then read: Stabilizing with tar by Fred Davis; with salt by A. R. Smith; with asphalt emulsion by G. E. Oldham; with cement by W. H. Mills, Jr.; with calcium chloride by L. L. Allen, and with asphalt by F. V. Reagel. Except in details these papers indicated the construction procedure to be nearly the same regardless of the stabilizing agent used. The old road surface is broken up to a depth of 5 or 6 in. and, with or without the addition of new material, the scarified soil is pulverized by harrowing or bleeding and spread flat for the application of the stabilizing agent. This is applied by sprinkling or spraying and mixed with the soil by blading or harrowing; the mixed soil and its binder are then compacted and rolled to cross-section.

While normal procedure has been to use the standard equipment described, special tools and devices are being tried out in individual operations. In asphalt stabilization R. V. Reagel referred to the use in his operations of traveling road mixing plants and of suboiling machines. (An article by Mr. Reagel on these two machine operations will be published in an early issue.) In calcium chloride work in Minnesota, L. L. Allen spoke of a traveling plant that picked up soil from a windrow and carried it to a pugmill where the chemical was added and from which the mixed material was discharged onto the road and then spread and compacted. An increasing practice, said L. C. Stewart, was the installation by pit owners of central mixing plants in which the coarse aggregate, the sand and the clay are mixed in proper proportions and then hauled to the road, spread and compacted. Complete plants, said Mr. Stewart are now on the market or can be assembled from gravel and clay conditioning equipment now available.

Speaking particularly of stabilization with tar, G. E. Martin emphasized the fact that stabilization is yet experimental and it is too early to set definite standards for practice. Each operation, he said, is a separate problem. A method of simple field testing and control needs to be developed. In preparing the road surface better pulverization is necessary and in general better equipment is needed for all processes. In compaction the sheeps-foot roller has proven to be a definite improvement. In tar stabilization, Mr. Martin indicated that application in layers offers advantages for consideration; it is also indicated in finishing that a cold prime coat and a hot seal coat are preferable.

Further emphasis was laid on field control by A. R. Smith in discussing stabilization with sodium chloride. He is using salt brine in preference to granular salt and is applying it so as to get about 2½ lb. of salt per square yard. For compaction a sheeps-foot roller followed by a 10-ton three-wheel roller are used. A reference was also made by Mr. Smith to the use of a nine-wheel trailer roller with a platform top on which sand bags or other weights are loaded to get the pressure desired.

A discussion by C. A. Hogentogler on film development and action on soil particles and a progress report by H. F. Clemmer of the A.R.B.A. and Highway Research Board joint committee on development of equipment for stabilization closed the two sessions on stabilization.

Forming a part of this consideration of foundation stability, but discussed in a separate session, were several papers on drainage. Three of these described pipe materials: Clay tile by J. I. Childs; concrete pipe by H. C. Delzell, and corrugated metal pipe by W. C. Martin. Ditching methods and slide prevention by blasting were described by L.

F. Livingston. Six short papers on current state practice were: Indiana by C. W. McClain; North Carolina by W. V. Baise; Pennsylvania by H. S. Mattimore; Virginia by C. S. Mullen; and Washington by Bailey Tremper. In a more general paper on drainage, R. E. Cotton presented and discussed some score or so of subdrain locations with respect to road cross-sections.

City road problems

Four sessions of the city officials division were held. A round dozen committee reports and individual papers were read, of which only a few aroused any considerable discussion, these being the report on federal road aid to municipalities by D. L. Lewis and a paper on the same subject by W. A. Alsdorf and a paper on WPA aid to municipal street projects by R. W. Crawford. Both documents presented arguments for extension of federal aid to city roads.

In discussion, James Wilson of Louisville, Jefferson County, Kentucky stated that the people of Jefferson County had contributed 40 percent of the highway funds and the county has yet to receive any of that money, in any form, in the past 20 years. He expressed the hope that the state will give part of the gas tax and license and registration fees back to the counties.

C. O. Judson, St. Joseph, Mo., city engineer, stated that his city and county maintain the streets on their own respective incomes. The city has a 1¢ gasoline tax which was placed on the people by local ordinance and this has assisted the city tremendously. However, the administration has taken ½¢ and used it for other purposes; consequently the roadways suffer. If the state would only accept the county roads, built to state specifications, and maintain them, Mr. Judson feels that the county could reduce its maintenance expenses materially.

W. H. Frickstadt of Oakland, Calif., stated that the general consensus of opinion of a large number of engineers is that if the gas tax money were used and spent according to the population, and distributed on that particular basis, people would get better roads where the population was greatest and consequently the support to the gas tax would be greater. He claims that the gas tax leaves a bad taste in the mouths of the population when used for anything but its supposed purpose.

Paul Nastasio, city commissioner, Long Branch, N. J., stated that the state of New Jersey was an example of what diversion in gas taxes had meant to the highway departments. In the recent legislation large sums of money were diverted from the gas tax collection to emergency relief purposes. This was necessary to obtain funds from the federal government which would only match dollar for dollar the money put up by the states.

Paul J. Essick, Jr., deputy chief, bureau of highways, Philadelphia, presented a paper, which was read by Edwin J. Miller, superintendent of highways, Rochester, N. Y. The subject was general maintenance and covered the routine tasks familiar to road builders. Discussion on the subject was carried by P. W. Metzell, city engineer, Columbus, Ohio, and also by C. M. Pinkney of New York city. Mr. Pinkney stated that the city of New York pays 70 per cent of the total gas tax of the state and he feels that it should get that money for use on highways throughout the city.

Other papers in this session were by Julius Adler, consulting engineer, Atlantic Refining Co., on "Asphalt-From its Source to its Use"; by W. J. D. Reed-Lewis, of the Lawrence Portland Cement Co., on "Cement—The Living Tissue of Concrete"; by L. A. S. Wood, chief lighting engineer, Westinghouse Electric and Manufacturing Co., on "It is Dark When the Street Lights Are On"; by Robert B. Brooks, consulting engineer, St. Louis, Mo., who gave a report from the committee on grade crossings; by Frank J. McDevitt, director of streets and sewers, St. Louis, Mo., who gave the report of the committee on traffic; and by Fred Bay, engineer of permits and licenses, bureau of highways, Philadelphia, Pa., who gave the report of the committee on subsurface structures.

Q. A. Campbell, asst. chief engineer, National Paving Brick Association, presented a talk on the manufacture and use of vitrified paving brick, using a moving picture, A. H. Guillot, engineer, New Orleans Public Service, Inc., spoke on "Street Railway Track Construction". Harry Jacobs, chief engineer, State Board of Engineers of New Orleans, Louisiana gave a talk on "Mississippi River Flood Prevention". Alfred F. Theard, superintendent, Sewerage and Water Board of New Orleans, La., spoke on "Sewerage, Water and Drainage in New Orleans,".

Road Show Highlights

New developments and trends in construction equipment as revealed by interviews with exhibitors at the New Orleans show

THE MARKED TRENDS of development in construction equipment noted at the Road Show last year are still clearly in evidence, judging by the New Orleans show of last week. These trends include the swing to rubber tire mountings, use of alloy steels to reduce weight and to lengthen the life of equipment, the streamlining of units for the sake of better appearance, and the constant attempt to make operation easier. Very little radically new or different equipment was reported, but every manufacturer produced evidence of his desire for constant improvement and refinement of his line of machinery.

The New Orleans exhibit, held in connection with the 34th annual convention of the American Road Builders Association, was in marked contrast to the elaborate exhibition at Cleveland last year. The New Orleans show, as was intended, was limited to small booth displays, with very little actual equipment being shown other than samples of materials, models of machines and picture and catalog displays. Some 130 firms had booths on two floors of the municipal auditorium, and a few ambitious companies parked demonstrator machines outside the building.

Obviously it was impossible to obtain an impression of equipment trends and development by actual inspection, as was done last year at Cleveland, hence this report is based on interviews with exhibitors to learn what is new, what the manufacturers are doing, and what they contemplate for the coming year. It is limited to those firms actually reporting something new or different.

J. D. ADAMS CO., Indianapolis—This old-time grader house has come out with a new line of heavy-duty gas and diesel motor graders. Not forgetting the street problems of the small village and town, they now offer a small motor grader especially designed for the town road supervisor.

ALLIS CHALMERS MFG. CO., Milwaukee—A brand new S-O controlled ignition oil tractor, designed from scratch, was the big feature at the Allis Chalmers booth. It is built especially to handle 7 to 8-yd. scrapers, 12-ft. blade graders and 10-yd. wagons. The engine has four cylinders, is rated at 64 hp., and the tractor travels under constant-mesh transmission at speeds of 1.5 to 6.4 m.p.h.

AMERICAN CONCRETE EXPANSION JOINT CO., Chicago — This company featured a new J-bar for replacing dowels in concrete pavements. Machined faces on the bar assembly place the two parts at exact right angles to the joint. It is designed for all types of joint material.

AMERICAN MANGANESE STEEL CO., Chicago Heights — The new Amsco counter-flow centrifugal pump, as used by Arthur A. Johnson at Quabbin Dike, was the chief topic of discussion at this booth. It is now built in all sizes from 6 in. up to 24 in., and is supposed to meet the dredgeman's urgent needs.

ARMCO CULVERT MFRS. ASSOCIATION Middletown—Armco is now invading the sewer pipe field with an asbestos-armored corrugated pipe. Sheet asbestos is pressed into the plate while the metal is still hot, and then the armor is given an asphalt coating. The pipe is paved at the invert as further protection. Armco is also talking about a new line of iron cribbing, designed with a vertical column at the front which takes the full load transmitted by the other sections. You can get this new cribbing with asbestos bonding for longer life, if you want it.

ATLAS POWDER CO., Wilmington—Contractors who like to make large blasting shots at one time will find the answer in the new Atlas Triple-50 blasting machine, which shoots 150 holes with one stroke of the plunger. Atlas also has a new line of Gelodyns, a semi-gelatine, water-resistant dynamite at lower cost.

AUSTIN WESTERN ROAD MACHINERY CO., Aurora—Rumor has it that Austin Western is going to Buda diesels on the small junior power grader. A new 5-yd. tractor-drawn loading scraper on four rubber tires supplements the A-W line of earth-moving equipment. This light rig is controlled by a single cable from the tractor. Of special interest to the roadbuilder is the development of two small portable crushing and screening plants with single crushers. Even smaller than these two rigs is a portable roadside crusher, to which can be attached an auxiliary screen if desired.

BARBER-GREENE CO., Aurora—W. B. Greene is enthusiastic about his new county-model mixer which can be used as either a central or traveling unit for bituminous or stabilized mixtures. After the bituminous materials are mixed Mr. Greene advises spreading and finishing with the Barber-Greene new tamping-bit spreader and finisher. The company also is putting out a new self-propelling belt loader.

BARNES MFG. CO., Mansfield, Ohio—The old line of Barnes pumps has been extended for the road contractor by adapting a model long used in oil fields to suit the needs of the roadbuilder. This is the Barnes outside-packed pump that will push 25 g.p.m. 1½ mi. all day long without overload. It takes the place of the large road pump, weighs only 2,100 lbs., and is mounted on large wheels. Barnes now puts the check valve on their pumps in the suction head, eliminating several fittings.

BLAW-KNOX CO., Pittsburgh—This year the big attraction at the Blaw-Knox booth was the new self-aligning road form. It is self-aligning with the help of a double wedge system that holds the stake in a floating position in a slotted gusset brace. The whole form is built to withstand the punishment of the heavy finishing and subgrading machines now in use. The B-K line of concrete and bituminous finishing machines has been redeveloped to provide the finishing capacity required to keep up with modern plant outputs.

BUCYRUS-ERIE CO., Milwaukee—New ½-yd. and ⅝-yd. shovels powered by gas, diesel or electric motors round out the line of Bucyrus-Erie full revolving shovels from ⅜-yd. to 30-yd. in capacity. This company is now pushing a new line of Bucyrus-Armstrong well and blast hole drills. It also has set a bulldozer blade on an angle and call it a bullgrader. A new line of carrying scrapers from 4 to 7 yd., on two or four pneumatic tires, appears in Bucyrus-Erie literature. A 12-yd. scraper will soon roll off the assembly line.

THE BUDA COMPANY, Harvey, Ill.—Talk around the Buda booth was diesel—all diesel and nothing else. Keeping up with the popular demand for ⅜, ½ and ⅝-yd. shovels and small cranes, Buda has developed two new diesel engines for these particular units. The new engines are 6-cylinder, four-cycle, full diesels of light weight and fast speed, designed with torque characteristics to handle loads fluctuating from nothing to peak in a few seconds.

BUDDE EQUIPMENT CO., Newark, N. J.—To its Brokol line of bituminous equipment, Budde has added a new dripless distributor spray bar for all types of oils and emulsions, and a generator type burner for heaters and distributors that has a positive cutoff at the seat.

THE PHILIP CAREY CO., Lockland, Ohio—Carey maintains that five years of development and test work on its rubber elastite has proven this new material and now highly recommends it for all expansion joint installations in pavements, bridges, walls and buildings.

CATERPILLAR TRACTOR CO., Peoria—Caterpillar announced its 25,000th diesel job is out at work somewhere. A year ago they were talking about the 10,000th diesel unit.

CHAIN BELT CO., Milwaukee—A new 8-in. size has been added to the line of Rex self-priming centrifugal pumps, topping out the range of sizes from 2 in. up. The others in the series have been redesigned this past year. It was inevitable that a smaller portable Pumpcrete unit should appear—and here it is—the new Model 160 on pneumatic tires, rated at 15 to 18-yd. capacity per hr., about 20 per cent under that of the larger standard machines.

CLEVELAND TRACTOR CO., Cleveland—Cletracs now have round-nose streamlined hoods. If this trend toward good looks keeps up we can expect uniformed chauffeurs to replace the well-known cat skinners as pilots of tractors.

CONTINENTAL MOTORS CORP., Detroit—This company's Tiny Tim generator will supply 200 watts at 6 volts. This small gasoline generating set weighs only 57 lbs. equipped for business, will start at the push of a button, and will shut itself off when the battery is fully charged.

DIAMOND IRON WORKS, Minneapolis—Compactness in a portable crushing and screening plant has been sought in Diamond's new Model 65 plant equipped with the Rotor Lift, a rubber-lined saucer that transfers material from both the jaw and roller crushers to the main plant conveyor with a minimum of effort and practically no head room requirements.

EUCLID ROAD MACHINERY CO., Cleveland—This company is putting out an end-dump model of TracTruck in a large size—12 to 15 yd. It has four air brakes, a 125-hp. diesel engine and sandwich-type body—a layer of oak planking between steel plates as a shock absorber. The drive wheels are 13.5x24-in. dual pneumatics.

FAIRBANKS-MORSE & CO., Chicago—The F-M platform scale now is equipped with an automatic printing and adding gadget for recording each and every weight. More new units are 4-cyl. and 6-cyl. diesel power plants, fully enclosed, of 40 and 120 hp. capacity, respectively. Bilt-Together pumps—electric motors direct connected to centrifugal pumps—are now available in a new 4-in. size with an output of 900 g.p.m. at 110-ft. head.

THE FOOTE CO., Nunda, N. Y.—A new type of fine grader that propels itself along on the road forms and leaves a finished subgrade behind is being put out by Foote. The rig undercuts ¼ in. below the final grade, elevates the grade material to a screen, relays and then rolls the subgrade, kicking all surplus material off to one side out of the way.

GALION IRON WORKS & MFG. CO., Galion, Ohio—This company is offering a new sanding machine that rides on its own single wheel behind any dump truck and scatters sand, cinders, stone chips, etc. at high speed.

GENERAL ELECTRIC CO., Schenectady—The effect of lighting of highways was demonstrated by G-E with a simple model. Car lights seemed to fully light the road, but when highway lights were turned on there were revealed several persons in the roadway not seen before.

B. F. GOODRICH Co., Akron, Ohio—First time at a Road Show, these tire-makers were displaying a new type of rubber expansion joint material that attracted a lot of attention. It is recommended for concrete highways, walls, floors and bridges. Goodrich also displayed a revolutionary rubber track for tractors and crawler tread wagons. No pins, no sleeves, no links, no grief (so they say) but simply a high-speed endless track that ends traction worries.

GORMAN-RUPP Co., Mansfield, Ohio—A new vertical triplex road pump designed for contractors is put out by this company. It is designed to throw 100 g.p.m. at 600 lb. pressure, or 75 g.p.m. at 800 lb. The rig is fully enclosed and is self-oiling.

HARNISCHFEGER CORP., Milwaukee—Harnischfeger is putting out a couple of new huskies in the shape of a 2-yd. heavy duty Model 855 shovel designed for diesel power, and the Model 955 dragline that swings a 2½-yd. bucket at the end of an 80-ft. boom with ease. The dragline is also diesel powered.

HERCULES MOTORS CORP., Canton, Ohio—A new 3x4-in. 2-cyl. gas engine appears in the Hercules catalog. The 4-cylinder line of gas engines is now complete with every size from 2½x3-in. to 6¼x7-in. Two new 6-cylinder units have filled out this line also. New model diesels, all 6-cylinder, from 60 to 140 hp. were on display.

HIGHWAY STEEL PRODUCTS Co., Chicago Heights—Medial Traffic Divider is the name this firm gives a queer-looking cast steel gadget with a twist in it. The idea of is to keep traffic in its own lane; the twist drops the wheel back onto the road if a car tries to climb over. They make similar guides from pressed steel. The company also supplies a double-jointed dowel bar and Crosslode expansion joints—the latter are armored joints of any material carrying a laminated cross bar.

FRANK G. HOUGH Co., Chicago—Hough now mounts its ½-yd. hydraulic shovel and loader on a long-base tractor. The shovel can be converted into the Hough bulldozer in 10 minutes of adjustment by one man.

HUGHES-KEENAN Co., Mansfield, Ohio—Pile drivers have gone miniature in the new H-K Gaty Hole Driver. This is a tractor-mounted rig that pounds a plunger into the ground, displacing the material by side compression, leaving a beautifully formed hole for guard rail posts.

INSLEY MFG. Co., Indianapolis—Featured a ⅜-yd. full revolving shovel, equipped with double tubular dipper shafts, and weighing only 9 tons. The same kind of rig also sports a back hoe. Rubber-tired trailers for hauling these midgets over the road are auxiliary equipment.

INTERNATIONAL HARVESTER Co., Chicago.—The PD-80 6-cyl. diesel engine, rated at 80 to 100 hp. is about all that's new here, according to the boys on duty at the booth.

JAEGER MACHINE Co., Columbus—Plenty of new units reported, such as a high-head single-stage 3-in. self-priming centrifugal pump, a new line of hoists from 10 to 100 hp., and 8-ft. pneumatic-tired concrete carts to fill the gap between the 6 and 11-ft. sizes. Longer pug mills have been added to the Triple Pug Mill mix and placing machine.

JOHNS-MANVILLE Co., New York—Going in for magic with a new compressed cork expansion joint, which is delivered in its compressed state, set in the joint like any other material, then becomes alive, keeping the joint filled without extrusion under all temperature ranges. The action of livening up comes through moisture absorption.

KEYSTONE DRILLER Co., Beaver Falls—Concentrated this year on a 1-yd. or 1¼-yd. excavator rigged as a trench hoe, skimmer scoop, dragline, clamshell unit or crane and powered by gas, diesel or electricity. Planetary gear cluthes are a feature of swing and lift mechanisms. Swing control is by foot or hand; bucket trip is by electric control button on the hoist lever. The whole rig is designed for easy operation. Skimmer scoop is bottom dump, and is said to be able to rip up an 8-in. concrete slab without outside help.

KOEHRING Co., Milwaukee—Long-range cranes are Koering's contribution to new equipment this year, along with a ⅝-yd. high speed shovel, 1-yd. and 1¼-yd. heavy-duty shovels, a Trail-Dump tractor wagon, a longitudinal finishing machine and tilting concrete mixers in 2 and 4-yd. sizes.

LACLEDE STEEL Co., St. Louis—Talked mostly about the Sentry Highway Guard, a steel plate with special fittings, and Laclede Dowel Spacers, which are easily installed and insure accurate joints.

LAPLANTE-CHOATE MFG. Co., Cedar Rapids—Announced a new 19-yd. (water level) wagon on six pneumatic tires, with hydraulic-control bottom dump.

R. G. LETOURNEAU, INC., Peoria—By adding one sliding bucket on the back of standard carryall scrapers, we now have the new Model U line from 6 to 18-yd. sizes, all cable controlled. The angle dozers and bulldozers have been redesigned to permit a much higher lift by cable control. While most other manufacturers are warning of rising equipment prices, LeTourneau announces price reductions in the entire line ranging from 7 to 12 per cent.

LINK BELT Co., Chicago—Wants to make sissies out of the shovel runners with a new idea in hydraulic control known as Speed-O-Matic. A flip of the wrist with a set of short levers accomplishes all that could be done before by heaving hard on long levers and stamping on brake pedals. The idea of ease has permeated to furnishing of upholstered seats for the operators.

MALL TOOL Co., Chicago—Exhibited the entire line of Mall vibrators, pumps, grinders and surfacers which have been redesigned for faster work all around. In this exhibit one batch of concrete was juggled, agitated and vibrated all week; dolomite dust replaced the usual cement.

MARION STEAM SHOVEL Co., Marion, Ohio—Proudly announced the 39-A dragline, a new rig designed as a dragline and crane, not as a convertible machine. It is equipped with oil-engine or electric drive, and will handle a 2½-yd. bucket at the end of an 80-ft. boom.

MASTER VIBRATOR Co., Dayton—The Packard Welders and Thawers are a new line with Master. They seem to come in a wide variety of sizes, but all are mounted on two-wheel carriages.

NOVO ENGINE Co., Lansing—The midget 2-in. self-primer centrifugal pump, carrying its own one-lung gas engine and mounted on a pneumatic tire about the size of a husky doughnut, was one of the hits of the show. Streamlined handles perk up the appearance of the rig. It delivers 6,000 g.p.h. The show pump is now on its way to Honduras by airplane to serve a highway contractor.

THE OSGOOD Co., Marion, Ohio—In league with Hercules Co. and General Excavator, Osgood announced a new ⅜-yd. shovel, full revolving and known as the Invader—the all-purpose machine. Hercules has added the Ironer auxiliary roller as a trailer to its road rollers.

PIONEER GRAVEL EQUIPMENT Co., Minneapolis—Soil stabilization has attracted the attention of the manufacturers, and Pioneer announced a brand new portable stabilizer plant It has a clay feeder, a stabilizing agent feeder and hopper, a water pump and spray pump, a clay shredder and a pug mill. Pioneer also announced a crusher trailer—to bring the crusher to the rock. Horizontal gradation screens are also new with Pioneer.

RANSOME CONCRETE MACHINERY Co., Dunellen, N. J.—Truck mixers and agitators have been added to the Ransome line. Other additions to the mixer group are a 5-S tilter, a mortar mixer and a small asphalt mixer. The popular dual-drum paver has been improved.

SCHRAMM, INC., West Chester, Pa.—Streamlined air compressors are now rolling out of the Schramm plant—the

ugly old compressor that has pumped concentrated atmosphere all these years is now spruced up to look like a deluxe auto or a racing yacht. Schramm specializes in the utility line of compressors—portable rigs of all sizes and shapes. They are gas or diesel powered, and run from 85 to 420 ft. in capacity.

SERVICISED PRODUCTS CORP., Chicago—Showed an asphalt expansion joint full of air cells for compressibility, with or without dowel supports. Also a new asphalt joint in a metal overcoat—extrusion chambers take up the squeezed material.

T. L. SMITH Co., Milwaukee—Tilt or non-tilt, whichever you prefer in concrete mixers, can now be supplied by Smith. The new 28-S is the latest addition to the non-tilters, while a tiny 3½ S tilter looks like a working model of the old-time Smith 1-yd. tilter.

SPEEDER MACHINERY Co., Cedar Rapids, Ia.—Announces new model shovels in ½-yd. and ¾-yd. sizes. These are crawler mounted, but the truck-mounted line is now complete from ⅜- to ¾-yd. sizes.

STERLING MACHINERY Co., Kansas City—Announced a new 2-in. self-priming centrifugal pump hooked up to an air-cooled Wisconsin engine. In one big jump they go to the other end of pump sizes wtih a new 10-in. of 200,000 g.p.h. capacity. Well pointers and pile drivers will be interested in a new self-priming jet pump agitated by a Ford V-8 engine.

TIMKEN ROLLER BEARING Co., Canton, Ohio—Streamlining has extended to detachable rock drill bits. Timken now makes them look good, but probably more important is the use of improved steels.

TRUSCON STEEL Co., Youngstown—Pressed steel centerline strips with dowels of T-section, and continuous welded dowel bar supports are all new items in the Truscon line of road reinforcing. The exhibit included an X-ray flashing sign showing a concrete road's innards of steel.

WAUKESHA MOTOR Co., Waukesha, Wisc.—Has added numerous sizes of 6-cyl. gas engines and 6-cyl. diesels to round out its line of heavy-duty engines of both types. A 300-hp. Hesselman oil engine was featured.

College Professors Divide on Taxation

TO OBTAIN a comprehensive picture of mature, responsible and independent tax opinion Mark Graves, president of the New York Tax Commission, recently propounded 116 questions to professors of public finance in 200 American universities. He received 126 replies, which answered 14,782 queries with 6,693 ayes, 6,121 noes and 1,918 doubtful or qualified answers.

Some of the queries and the returns on them are given in the following table:

PARTIAL RESULTS OF QUESTIONNAIRE ON TAXATION ANSWERED BY 126 PROFESSORS

Question	For	Against	In Doubt
Property Taxation			
Retention of property tax as major source of local revenue	97	26	4
Improvements taxed at a lower rate than land	70	41	16
Special tax on unearned increment of land values	63	44	20
Special yield tax in place of property tax for forest properties	109	8	10
Homestead exemptions	35	81	11
Personal Income Taxes			
Graduated personal income tax	126	0	1
All future federal, state and local securities issued fully taxable as to income	109	10	8
Business Taxes			
Net income tax on corporations	120	7	0
Gross tax on business incomes	11	92	24
Such occupational business taxes as those in the Southern States	10	94	23
Banking taxed differently from general incorporated business	65	45	17
Ditto, railway and public utility business	73	38	16
Special taxes to discourage chain stores	8	114	5
Gasoline and Motor Vehicle Taxes			
Motor vehicle fees approximately equal to cost of police regulation of motor traffic	62	45	20
Tax on motor vehicles as such with exemption from general property tax	87	25	15
Gasoline tax to pay for all highway construction (federal, state and local)	57	51	19
Gasoline tax to pay for all highway construction and maintenance	56	55	16
Highway costs paid partly by levies on property	66	42	19
Mandatory use of gasoline and motor vehicle taxes for highways (including streets and bridges)	81	39	7
Entire highway system outside of incorporated places financed, constructed and maintained by states instead of left under jurisdiction of local governments	105	9	13
Through routes through incorporated places financed as above	105	7	15
General Retail Sales Tax			
Federal	16	101	10
State	24	87	16
Local	2	119	6
Producers Sales Tax			
Federal	21	92	14
State	7	111	9
Local	3	119	5
Relationship of Federal, State and Local Jurisdictions			
Increase in federal control over child labor	101	15	11
Ditto, control over other labor relations	75	32	20
Ditto, over manufacturing	61	44	13
Ditto, over merchandising	54	51	12
Prefer such teamwork as may be necessary between states aside from that now provided for by the federal constitution to be handled through state compacts instead of changing the constitution to increase the federal powers	66	38	23
State supervision of local assessment	123	4	0
State constitutional tax limit provisions	24	98	5
County assessment of real estate	89	18	20
Town, city or village assessment	15	86	26
Board of state engineers to determine taxable valuations of all difficult properties such as railways and public utilities	119	1	7
State and federal aid distributed on the basis of need	103	7	17
State constitutional limitation of debt-incurring powers of local governments	41	74	12
State statute limitation of debt-incurring powers of local governments	96	17	14
Abolition of towns with transfer of functions to county or state	47	51	29
Corporations incorporated federally and paying federal incorporation and annual fees and none to state	64	40	23

Arthur Morgan States His Views on National Power Policy

Public statement by the chairman of the Tennessee Valley Authority argues for cooperation with the utilities and indicates principles of power control.

IN A STATEMENT *released to the press on Jan. 17 under the title "A Personal View of the Electric Power Issue," TVA chairman Arthur E. Morgan presented an outline of a public power development and operating policy, framed primarily with application to Tennessee Valley conditions but indicated as applicable to the relation of public and private power everywhere. Essentially the Morgan plan is for a transmission pool in which the private and public power systems would join. An important feature is the stipulation that when a city takes over power distribution within its own limits it should also dstribute to a surrounding distrct, as the latter, being a thin market, could not alone support its service at practicable rates. Extracts from the statement follow.* EDITOR

AN IMPORTANT DECISION is involved in the treatment of the power issue in the TVA territory. Shall there be an effort on the part of public officials to work with the private utility companies to remove abuses, to insure maximum service at minimum cost, and to insure opportunity for public ownership where it is desired; or shall men who administer public projects drift into an attitude of a fight to the finish against the private power companies?

I believe we should deal with the private power companies to the end of eliminating abuses, while preserving the right of the people to acquire their own power service by public ownership if they choose. In the process of transition from private to public ownership, there should be respect for legitimate private investments in the utility business, and individual local communities should be required to respect the interests of the larger communities of which they are a part by preservng the economy and efficiency of well-integrated power systems. It is not wise to so center attention upon utility abuses as to fail to see the great achievements of the electric power industry in America. There has been an intelligent aggressiveness in technical development and activity in the integration of the industry which has brought about a high level of convenience and service.

I do not advocate cooperation through any naive belief that the private companies have a consistent record of good behavior. I have come to the belief that the attitude of a ruthless fight to the finish and without quarter against public ownership of power has been a characteristic position of the private utilities. One of the chief obstacles to effective cooperation of the government with the power industry is the continuance in positions of power and authority of some utility men who seem not to have changed their habits of mind from the days of exploitation and unscrupulous use of power. So long as those in ultimate control of the industry choose to be represented by such men, the position of those who stand for open and impartial dealing with the industry is made extremely difficult.

Seek basis for agreement

I believe that at the present time the proper attitude to take with reference to TVA power is to strive to find a basis of agreement bewteen the TVA and the private utilities which will protect both public and private investments, and will lead to the widest possible distribution of electric power at the lowest possible rates. Since the creation of the Tennessee Valley Authority I have taken that attitude.

I believe that some leading utility executives are today in a mood to desire a reasonable working arrangement, and that it may be possible to arrive at a solution which will protect both public and private interests.

If the power issue can be worked out by the process of open analysis under qualified leadership, with both sides disclosing all facts, and with honest recognition of difficulties, the solution may not be perfect, but it will be a contribution to good government, and the invaluable habit of reaching the solution of public issues by reasonable methods would be strengthened. I regret to say that the power companies in the Tennessee Valley region have not been assured as to what are the intentions of the TVA concerning them.

I favor enough public ownership to enable the country to work out effective methods on a life-sized scale, but not so much public ownership that we shall be swamped by inefficiency before we learn how to make it effective and economical. The people have a right to actual examples of public ownership to supply a basis for coming to long-time conclusions on the subject. We should not be forced to decide by abstract theory.

Duplication of facilities should be avoided. If a community undertakes public ownership, the existing private properties should be taken over at a fair price, as determined by agreement or by impartial appraisal. There should be effort to avoid arbitrary disruption of existing efficient systems. Distribution districts should be large enough to justify good management, engineering and other technical service, and adequate operating equipment. They should be large enough for efficiency, but oversize and the resulting tendency to bureaucracy should be avoided. Study to determine the best size of operating districts is greatly needed.

The large private power networks within TVA transmission range depend for operating efficiency on a relatively small number of the larger cities. A campaign which would result in public ownership in ten to twenty of these cities might practically destroy the ability of the large systems to render maximum service, or to maintain economical generation and transmission systems. Effort to bring about such disruption seems to be underway. On the other hand, if distribution areas of efficient size should be taken over by the public as units, and if the properties taken over should be paid for at reasonable prices, then transition from private to public ownership could be an orderly process without destructive disruption of existing systems, and public projects would not compete with each other in a scramble to grab the best nearby territory and to avoid the less profitable communities.

In reporting on public ownership in "yardstick" undertakings, public statements should be fair and representative. There should be no hidden subsidies, either of money or services.

Sale of power

If the TVA has power over and above its own needs and the needs of all its other customers, it should sell that power to the private utilities at about what it would cost the private utilities to generate their own power. The private utilities on the other hand, if assured of such supply, should not build additional generating plants until that assured supply of government power is fully used.

I am of the opinion that some type of power transmission pool, as recently suggested by the President, perhaps somewhat along the lines of the British grid system, may prove to be most desirable.

The power issue is not primarily a question of liberalism or conservatism, but of discovering how to do the job best. Compulsory cooperation of public and private power organizations may be the necessity which is the mother of invention. When the mature result is achieved it may be neither private power as we know it, nor public power as we know it, but something new in governmental methods.

CURRENT NOTES ON SEWAGE DISPOSAL

An analytical summary of recent developments conducted by

WILLEM RUDOLFS
Chief, N. J. Sewage Experiment Station
New Brunswick, N. J.

● "NATURAL PURIFICATION" OF BATHING POOL WATER

In the self-purification of river waters, in the treatment of sewage on trickling filters, and in the activated sludge process protozoa appear to play a role although their functions and extent of aid in purification are as yet not clearly understood. Kuipers, director of swimming and bathing pools in Amsterdam, Holland utilizes these protozoa as the active agents in a "natural purification" process (*De Brigade*, July 15, 1936) which he calls the "bio-filter system." His system is based on the fact that in nature pathogenic bacteria are killed in large numbers by other bacteria and protozoa. Therefore, by the introduction of specific species of protozoa which form a bacteriophage when sufficient oxygen is available, the *coli* organisms in the pool are destroyed. With the protozoa a special method of filtration is used to increase the oxygen content of the water, and this encourages the protozoa to remain active and causes oxidation of some soluble substances. It is further claimed that when all bacteria are destroyed the weaker members of the protozoan tribe are devoured for food, and this automatically produces strong and rather pure cultures of the desired protozoa. The introduction of sufficient air is important.

This system of bathing pool purification has been in operation for some time in Amsterdam, Bilthoven and Alkmaar, and recently about six other cities have adopted it. No other means of sterilization are used when protozoa are employed. Purification is said to be rapid, complete, self-perpetuating and accomplished at extremely low cost.

● STREAM POLLUTION AND TRADE WASTE

Stream pollution studies dealing with watercourses polluted by domestic and industrial wastes are appearing more frequently. A survey giving the chemical and biological conditions of a stream unpolluted at its source, receiving no untreated sewage but considerable volumes of textile wastes (*Report* West Riding of Yorkshire Rivers Board, No. 175, Oct. 1936), is unusual and of considerable interest, especially because the standards generally used for domestic type sewage pollution were found to be unsuitable. The investigators state that "the more one investigates the pollution of streams in districts which are the seat of manufacturing industries, the more convinced one becomes that the most effective, as well as the most economical, means of protecting our rivers from damage due to the discharge of trade liquids is the treatment of these liquids, when practicable, at the sewage works of the local authority." The unpolluted reaches of the stream were found to support stream life characteristic of natural fresh water, but immediately below the outfall of the first mill most of the fresh water plant organisms and many of the animal organisms had disappeared. The change could not readily be attributed to any peculiar character or constituent of the waste effluent, because this was usually satisfactory according to the standards generally accepted for the type of waste treated. It appears that trade effluents may exercise a greater influence on the normal biological conditions of a stream than do sewage effluents of similar impurity.

● SEWAGE AERATION WITH ASBESTOS

Methods of straight aeration without the return of sludge have been practiced in this country and abroad with more or less success. Attempts to increase the rate of settling of activated sludge with the aid of inert materials are reported from time to time. A method whereby no sludge is returned but an inert substance is substituted resulting in a decreased rate of settling is of more than theoretical interest if the claims are substantiated. Zigerli (*Schweitzerische Bauzeitung*, 108, No. 6, 1936) describing his "Z-method" of secondary treatment of settling sewage practiced at St. Gallen (Switzerland) claims that he obtains nearly the same degree of purification—95 per cent suspended solids removal and 80 per cent B.O.D. reduction—as activated sludge with a much shorter aeration period (only one hour). To clarified sewage passing to the aeration chamber, finely divided asbestos fibers are added. After sedimentation the effluent is passed through slag at a high rate. Part of the settled asbestos and sludge is returned to the aeration chamber. Information regarding the quantities of asbestos added, volume of air, amount of sludge produced, specific purification results, etc., are not available. The test plant is small and does not have measuring devices. Visitors state that similar results could probably be obtained without the addition of asbestos.

● ACTIVATED SLUDGE FOR TANNERY WASTE

Difficulties with biological treatment of organic industrial wastes are often due to the great variations in the type and strength of waste of a particular industry. Waste from a leather plant, for instance, may contain large quantities of tannins, organic sulfides and hydrogen sulfide. Where tannery industries are located in large communities the effect of the waste on treatment processes is inconsequential on account of the dilution from the relatively greater volume of domestic sewage. A large tannery in a small town, however, may create many difficulties, and when the industrial waste alone must be treated the difficulties are considerably magnified. The successful use of the activated sludge process for combined sewage and tannery waste is described by Pauschardt and Furkert (*Städtereinigung* Nos. 14 and 15, 1936). Following grease removal by air, the sewage is settled and then aerated for 5.5 hr. The surplus activated sludge is mixed with the poisonous tanning waste and thus the purification power inherent in this active sludge is completely utilized to good purpose. This method of operation produces a large volume of sludge for digestion. With the addition of from 45–50 per cent tannery waste to sewage it was possible to purify the mixtures to 80 per cent. Treatment of strong, variable tannery waste alone produced "good results."

● NITROGEN LOSSES

It has been surmised frequently that during the aeration process of activated sludge considerable nitrogen is lost in gaseous form, and consequently the fertilizer value of the sludge reduced. When a nitrogen balance is made at an activated sludge plant, taking into consideration the amounts which pass out with the effluent, as much as 20 to 30 per cent of the total is lost. Since the losses could not be accounted for by the material in the effluent, hence the assumption that nitrogen was lost in the air during aeration. Wooldridge and Standfast (*Biochemical Journal* 30, 145 148, 1936) studying liberation of gases from oxidation devices, conclude that under aerobic conditions of operation such gases as nitrogen, hydrogen, methane and hydrogen sulfide do not appear to be liberated during oxidation of ordinary sewage systems.

Letters to the Editor

Data Required for Flood Prediction

Sir—In view of the fact that great flood-control projects are being constructed and others are being planned, the paper by Robert E. Turner (Nov. 26, 1936, p. 751) is indeed timely. Although flood prediction can not be a substitute for flood control or prevention, except perhaps in sparsely settled communities, it is a valuable and in some cases an essential auxiliary to control. Flood-control works are expensive and all means of alleviation of flood suffering must be utilized to the fullest extent.

Reliance must be placed on flood-control works for any effective and substantial protection against floods since only goods which are easily moved can be placed beyond the reach of floods upon short notice. The amount of protection will depend, as Mr. Turner pointed out, upon the expected benefits. Complete protection, that is to say, total elimination of all flood losses, will be possible in only few cases, where the area to be protected is very highly developed or in event reliance is placed upon works the safety of which requires total protection. Partial protection will probably be all that can be obtained economically with reservoirs.

Full value of flood-control works will be obtained only with the maximum foreknowledge of expected floods. This is especially true when protection is obtained by a system of reservoir. In a few cases where reservoirs are utilized for other purposes in addition to flood control, prediction of floods or high water is indispensable.

Flood prediction based on observed rises of stage can serve only on the largest rivers. On small watersheds, say up to 5,000 or 6,000 square miles where the flood may reach a peak in two or three days after the rainfall, the prediction must be based on the amount of precipitation as it falls and upon the meteorological and hydrological conditions preceding the storm.

There appear to be four steps that should be taken to establish flood predictions based upon those conditions. It seems to the writer that the long-established functions of the Weather Bureau have been developed as far as practicable for obtaining the meteorological conditions except in two particulars. For better prediction of floods recourse must be made to two or more recent developments, one in meteorology, which the Weather Bureau is now utilizing to some extent and one in hydrology, which is being utilized by some hydro-electric companies for reservoir operation.

The first of the two particulars in which the Weather Bureau's work can be improved for flood prediction purposes is the extension of the regular precipitation stations into the headwaters and the divides of the watersheds, especially in rugged country where elevation makes a difference in rainfall. Most precipitation stations are located in the valleys. The value of stations in the divides is shown forcibly by the two storms which caused the floods of March, 1936, in New England; they centered in the White Mountains at a station which had been in existence only about six years. The second particular mentioned above is the establishment of more stations for obtaining hourly or continuous records. At least one and preferably two or more such stations should be maintained on each watershed where flood-control works are maintained.

Recent meteorological developments have shown that some of the most disastrous storms are the result of the meeting of two dissimilar air masses, that is, a cold and dry mass and a warm and moist one. Information of the movements of air masses is obtained by aerological soundings. Although the Weather Bureau has stations sufficient to chart the general courses of air masses, soundings spaced much closer together must be made to give information on the approaching relatively small contacts which are likely to produce heavy rainfall. This will necessitate many more stations for sounding the atmosphere.

In the northern tier of states, snow runoff is one of the principal causes of floods. In order to predict the spring flood or its possibilities, accurate information must be had of the snow cover on the watershed. This information must be obtained by snow surveys throughout the winter and should consist of data on the depth of snow cover and the water content. The winter temperatures and the depth of snow will reveal the capacity of the snow to hold water and the water content will indicate the quantity of runoff to be expected.

Given the depth and water equivalent of the snow cover, knowledge of air masses, and the cyclonic activity of the atmosphere, we should be in position to foretell possible floods before they occur.

Boston,
Dec. 10, 1936

EDGAR E. FOSTER
Associate Engineer, U. S. Engineer Office

Concrete Bridge Costs

Sir—Referring to the letter of Mr. Balog on Concrete Bridge Costs, *ENR*, Dec. 24, 1936, p. 904, the writer as designer of the Buckley Overpass is pleased to learn of the low costs Mr. Balog obtained in his concrete bridges in Wisconsin ten years ago. Very frequently it is believed that concrete bridges are necessarily costly bridges. This is not so.

Unit costs per square foot will vary in accordance with what is taken as the breadth of the bridge deck. The general custom along the Pacific Coast is to take the full roadway width and one-half the sidewalk widths. On this basis Mr. Balog's unit prices will be increase. On the other hand, if the total overall concrete breadth is taken, the unit price of the Buckley Overhead becomes $2.24 per sq.ft.

The total length of the Buckley Overhead (*ENR*, Nov. 5, 1936, p. 637) results from spans of 50-60-50-40 ft. and two cantilever ends of 11 ft. 6 in. average length. This overall length is not a function of the skew on which the bridge crosses over the railroad. It is not apparent how three 40-ft. spans skewed 60 deg. give the New Holstein structure a length other than 120 ft. for computing its deck area.

About a year ago the Division of Bridges, Bureau of Public Roads, published data and detailed estimates of costs of representative grade separation structures in various parts of the United States. With breadth based on roadway and *full* sidewalk width the square foot costs of bridges carrying highways over railroads were given as shown in the following table:

TABLE I—SUMMARY OF COMPARATIVE COSTS FOR BRIDGES OF VARIOUS TYPES

Type	No.	Cost per Sq. Ft. Lowest	Highest	Average
Reinforced concrete	30	$2.74	$5.89	$3.88
I-beams on concrete or steel piers or bents	20	3.01	6.40	3.91
I-beams on creosoted timber bents	3	2.50	2.88	2.64
I-beam main spans treated timber approaches	2	2.53	2.57	2.55
Steel girders on "open steel pile bents"	6	2.58	4.10	3.42

The Washington State Highway Department recently completed a large concrete trestle across the bottom lands of the Nisqually River on the relocated Pacific Highway between Fort Lewis and Olympia. Its deck is of beam and slab construction; the 30-ft. spans are continuous between expansion joints which are on 90-ft. centers. It averages 15 ft. in height above the ground. Bents are monolithic; there are four columns, carried on untreated wood pile foundations. The deck carries a 44-ft. roadway, one 3½-ft. sidewalk, monolithic concrete railings. Overall length 3,994 ft.; contract price $376,727. On the basis of roadway and half sidewalk the cost is $2.06 per sq.ft.; on the basis of roadway and full sidewalk the cost is $1.99 per sq.ft.

GEORGE RUNCIMAN,
President, W. H. Witt Co.

Seattle, Wash.,
Dec. 30, 1936.

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Editorial offices at 330 West 42nd Street, New York

January 21, 1937

The Safe Road

THE DISPERSED TECHNIQUE activities of the American Road Builders' Association tended to concentrate at the New Orleans convention last week in a purpose to promote safe road design and construction. For the present this new purpose is expressed definitely only in the work of the commitee on safe highways, but it could be perceived also in the discussions on base stabilization and foundation drainage, and even in fulminations against the diversion of road-use taxes. The tender sprout of a growing purpose needs to be cherished and brought to the surface. The A.R.B.A. stands virtually alone among road-building interests in championing the doctrine of building safety into the road, and it should drive forward vigorously with the campaign. Pursuing this objective need not imply any lessening of attention to other reforms —such as traffic control or driver conduct. Indeed, building safe roads will be the best contribution to the success of such related movements. Definition of the technique of road design and construction is the logical goal of the Association's efforts during 1937.

Lightening Lift Spans

THE 540-FT. LIFT SPAN of the Marine Parkway bridge at New York was floated into position last week. The longest highway lift span ever built, it would also have been the heaviest had its design followed practice that was common five years ago. By placing the operating machinery on the towers instead of at the center of the span and by using open-mesh steel decking weighing only 25 lb. per sq. ft. the designers effected a substantial saving in weight. The trend toward lighter lift spans has been strong in recent years, based on demonstrated savings in cost. Studies made in 1930, when a steel-plate deck was applied to the 534-ft. Burlington-Bristol Bridge over the Delaware River, showed that each extra pound in the floor added 12c. to the cost of structure and machinery. Last year a steel-plate floor surfaced with asphalt plank was used on the Harlem River lift span of the Triborough Bridge, and in Bridgeport, Conn., a floor of aluminum channels and asphalt plank was placed on an old bascule structure. Precedent for the open mesh decking of the Marine Parkway bridge rests in a number of smaller installations, notably one on the University Ave. bascule in Seattle, which has seen four years' service. As study and experiment proceed, movable bridges doubtless will continue to reflect the attempt to achieve savings in weight.

Stream Pollution Legislation

LAST YEAR several bills for stream pollution control were introduced in Congress, and one of them narrowly missed passage in the closing days of the session. This year proponents of pollution regulation are starting an early campaign to secure federal legislation. Already the Senate has before it the Lonergan and Barkley bills, the first providing for the permanent establishment of the National Resources Committee, which would be charged with controlling water pollution, while the second would utilize the U. S. Public Health Service as a coordinating body to make joint investigations with state agencies and thus aid in drafting comprehensive plans for improving the sanitary condition of rivers. Both bills make provision for federal financial aid. Of the two the Barkley measure (S702) offers the most promising approach to the problem. It recognizes the usefulness of existing state and local sanitary agencies and would maintain their integrity and function; the national point of view and coordination of effort which is essential where interstate streams are involved would be entrusted to an arm of the government that is qualified by technical experience and personnel to provide effective stimulation. The Lonergan bill, in contrast, makes mandatory the establishment of sanitary water districts, and in addition provides for rigid federal control. Any attempts toward centralization of this kind will undoubtedly meet with strong opposition. But regardless of the merits or weaknesses of suggested legislation, the happy fact is that stream pollution control is receiving prompt attention from our law-makers.

Shaping a Policy

ARTHUR E. MORGAN'S personal statement on the relations between public and private power, and the President's subsequent appointment of a board to outline a power policy (see p. 101 of this issue) is the first indication of constructive action by the administration on the much disputed subject of government and the utilities. For three and a half years the subject has been left in the state of confusion that resulted from starting uncoordinated power-plant construction on the Columbia, the Tennessee and elsewhere. The National Power Policy Committee did nothing, and the confusion became worse as the plants neared completion or went into operation. One of the results was trouble for the utilities, which could not tell whether to undertake improvements or not, but the chief sufferers were the power users, that is the public. Industries that wanted to build new plants near power centers were unable to choose their sites, since the necessary information on power supply, costs and policies was unavailable. Equally bad effects resulted from the serious doubts that were awakened in many minds as to the good faith of the public authorities—even doubt as to their intelligence, for the situation, especially on the Columbia, clearly suggested that the government did not know what it was doing. The pooling plan suggested by the Morgan statement for the first time offers something workable and definite. Still more important, however, are the principles on which it rests, for these principles mark out a course of thinking that in the end is bound to prevail.

True Engineering

THE FACT THAT TRUE ENGINEERING involves a large amount of sound judgment in the interpretation of assembled scientific data is well exemplified in the design of the spillway for Bonneville Dam. Soon after it was decided to build the dam, model studies of the spillway were begun, for it was realized that serious erosion would occur below the spillway if the energy of the vast flow over the spillway were not dissipated above riverbed

level. These studies indicated that the level of the deck below the dam should be at El. —8 for best results under conditions as they will exist when the structure is completed. What the studies did not show, but what the investigators concluded from experience gained elsewhere would be the case was that the stream, relieved of its bedload as it enters the pool above the dam, will pick up a new bedload as it passes down the channel below the dam, thus producing slow recession of the bed and lowering the tailwater sufficiently to change the hydraulic conditions at the dam. If the river is dredged for deep-draft vessels, further lowering of the tailwater is likely. Considering those possibilities, the investigators lowered the deck 8 ft. farther; though for the present this level will give less satisfactory results, it promises to give better results in years to come. Neither observed facts alone nor judgment unsupported by experimental observation would have led to that conclusion; it was reached only by the combination of the two which is true engineering.

Spend the Money at Home

ALMOST any excuse is used by the advocates of the Nicaragua Canal to urge its construction upon Congress. This time it is the recent earthquake in Central America and the quite unimportant landslide in Culebra Cut. Nicaragua is urged as a major national defense issue, and the proponents point out that Lieut. Col. Dan I. Sultan, following his recent careful study of the territory through which the canal would be built, found that its construction was "feasible"—*to the tune of $722,000,000.*

It is argued that two canals would give the nation much greater assurance of being able to keep a route open between the Atlantic and the Pacific oceans than would one, and the two could be defended almost as easily as one. Granted. But three would give even greater factor of safety; so why stop at building one more? In this day of the rising importance of the airplane as a means of defense there is reason to question whether any canal is essential to the defense of the nation against outside attack. Certainly, until we know more about the possibility of battleships soon becoming obsolete as a means of defending the United States against outside attack, national defense should not be made an excuse for building a second canal.

The decision should hang on whether or not another canal is needed for commercial reasons. And the answer to that is no! The addition of a second chamber to each of the locks at Panama—now being definitely planned—will provide adequate capacity for many years to come. The fact that Col. Sultan found the Nicaragua canal "feasible" is without significance. Modern engineering and construction skill can make a canal at almost any location feasible. The question that Col. Sultan should have been asked to answer is: "Is such a canal economically justified?" But the answer to that was known before Col. Sultan started for Nicaragua.

The $722,000,000 that the canal will cost would be spent in a foreign land, where its expenditure would be least useful, and the nation would be saddled with the continuing annual cost of operating and maintaining a second canal that serves only to divert traffic from the Panama Canal. If the nation has $722,000,000 to spend it should be spent within its own borders for a multitude of useful and needed projects.

Work Relief or Reemployment

LAST MONTH marked the third anniversary of the Federal work-relief system, first set up under the name of Civil Works Administration (CWA) near the close of 1933. Originally planned to avoid all trespass on the field of normal and necessary work that would have to be done regardless of relief, the system has increasingly entered into this field, and in doing so it has put thousands of self-supporting men out of work to create places for relief clients.

By virtue of this process the WPA, successor of the CWA, is today a major factor in perpetuating unemployment. What this means in practical terms is indicated by the latest published estimates of unemployed, which give figures of something over 8 million persons. Though no actual count of the unemployed has been made, the estimate figures are sufficient to give a picture of the situation.

In the next few weeks Congress will have to decide on continuing the work-relief system. This will be the first opportunity of the nation's representatives to declare a national policy respecting the question. Up to now the federal moneys applied to work-relief were voted as blanket sums for relief and reconstruction purposes, to be spent in the sole discretion of the President. Congress had no voice in determining the system or its operating policies, and Congress therefore is not to blame for its effect in maintaining a startlingly large unemployment roll in the face of revived industrial activity and an increasing shortage of workers.

The issue which Congress now has to consider is whether the national policy shall be directed toward perpetuated work relief or toward reemployment. Strong partisan forces are sure to make themselves felt. Already a number of mendicant city mayors are asking insistently for continuation of the current program so that they will not have to reassume their responsibility of taking care of the destitute, providing for the city's rehabilitation and construction needs, and thus building back to normal employment.

There are rumors even that an attempt will be made to take such normal work as federal-aid highway construction out of the field of free employment and turn it over to the relief brigades (see the AGC's warning *ENR* Dec. 3, 1936, p. 788). Such a rumor seems fantastic, but whoever has followed the ways of government relief knows that it is anything but fantastic. Whether by sanctioning such schemes or otherwise, ill-advised policy decisions by Congress might easily result in swelling the relief roll and making relief a chronic disease by preventing the return of regular workers to employment in regular jobs.

The question is not whether relief shall go on but whether the methods of relief are to be constructive or destructive—whether they are to promote reemployment or are to stand in the way of the normal working opportunities that exist in the regular and orderly conduct of government and business affairs. The WPA, as a serious obstacle to reemployment, ought to be abolished unless its methods can be radically revised. Relief may have to be continued by the federal government to the extent that the states and cities are not able to meet its full demands, but progressive reemployment must be the objective of its policy and procedure. To crystallize this vital principle into working form in its forthcoming relief legislation is the most important—and most difficult—duty that the coming Congress has to face.

CURRENT NEWS

Pollution Bill Introduced

Barkley Bill would provide for cooperation with state agencies on pollution and federal grants for prevention

A bill, S.702, introduced by Senator Barkley, and now before the Commerce Committee of the Senate, provides for the establishment in the U. S. Public Health Service of a division of water pollution control headed by a director who would be a commissioned engineer officer of the U. S. Public Health Service detailed by the Surgeon General with the rank of assistant surgeon-general.

It would be the duty of the division to prepare comprehensive plans in cooperation with agencies of the states and with municipalities and industries involved for eliminating or reducing the pollution of navigable waters and streams tributary thereto. Such comprehensive plans would be directed toward conserving the usefulness of the streams for public water supply, fishing, recreation, agriculture, and industry. The department would encourage interstate compacts and other cooperative activities directed against stream pollution and provide surveys and technical assistance for such work.

The act also would provide for 33⅓ per cent grants and loans to any public body for the construction of necessary treatment works which are approved by the state health authority and by the newly created division. Provision is made for loans, but no grants, to private industries for the same purpose.

The proposed law would provide for the establishment within the division of water pollution control of a board of five engineer officers of the Public Health Service. This board would be required to prepare a list of recommended projects eligible for loans or grants or both which would be submitted to Congress. Upon the basis of this report, Congress would then authorize those projects which were to receive loans and grants. This procedure would be similar to that now followed in the War Department's river and harbor work.

An appropriation of $1,000,000 per year beginning with the fiscal year starting July 1937 is authorized under the bill. Of this appropriation $300,000 would be devoted to meeting the administrative cost of the division of water pollution control, and $700,000 would be allotted to the states to meet the cost to them of cooperation with the federal program.

Cottrell Receives Washington Award

The Washington Award for 1937 has been presented to Frederick G. Cottrell, of Washington, D. C., who perfected the process by which the cost of helium was reduced from $1,700 to $0.10 per cubic foot. Dr. Cottrell is president of Research Associates, Inc. A chemist and metallurgist, he is a former director of the U. S. Bureau of Mines and director of the fixed nitrogen laboratory, U. S. Department of Agriculture.

The Washington Award is administered by the Western Society of Engineers in cooperation with the American Society of Civil Engineers, the American Institue of Mining and Metallurgical Engineers, the American Society of Mechanical Engineers, and the American Institute of Electrical Engineers. The award is made annually.

Village Sues Montreal On River Pollution

Suit has been instituted by the village of Cote St. Luc against the city of Montreal for damages of $103,000 arising from pollution of the St. Pierre River which flows through the village. This action carries out a threat made some months ago (*ENR*, July 16, 1936, p. 98). The claim is for $100,000 damages for which the city of Montreal is said to be responsible plus $3,000 as expenses so far incurred by the municipality of the village.

The damage arises from the delay in the long planned construction by the city of Montreal of the Trenholme Ave. trunk sewer, part of a program of sewer construction which the city was ordered to undertake some years ago by the provincial health authorities. Bids on the sewer were called for in Dec. 1935, but award of the contract was held up until the latter part of last year. Construction is now under way, but it will be some time before the sewer is ready for use.

Alabama Court Rules Against Parking Meters

The Alabama Supreme Court held on Jan. 14 that parking meters in Birmingham represented an "unauthorized exercise of the taxing power" of the city. The court ruled that a Birmingham ordinance authorizing the installation of parking meters was invalid, affirming the judgment of the Jefferson county circuit court.

The court held that parking meters had no relation to the proper regulation of parking but were part of a plan to raise revenue. It was stated that the parking meter tax was a "superimposed burden of an insidious indirect tax or charge on the right to park."

The decision was handed down in the case of the city of Birmingham against the Hood-McPherson Realty Co. and a companion case of the city against Odom, Bowers, and White, a clothing store.

Only two other cases involving the use of parking meters have been adjudicated in the courts. A lower court upheld the right of Oklahoma City to install meters, and a lower court decision supporting the use of meters in Miami has been upheld by the Florida supreme court.

Engineering Council Meets at Washington

Assembly emphasizes need for engineer's participation in economic and political activities

The increasing importance of more extensive participation by the engineering profession in economic and governmental affairs was the keynote of the 17th annual assembly of the American Engineering Council, held in Washington, D.C., Jan. 14-16. A number of delegates pointed out that such participation should not be limited to the activities of the council alone, but should be developed to a greater extent than in the past by its member bodies, extending the influence of the profession into state and local as well as federal affairs.

Experience with the revised committee set-up approved last year is favorable it was reported. All committees of the council are now grouped into four general classes dealing, respectively, with public affairs, programs for united action, engineering economics, and the internal affairs of the organization. Heading the latter division is the executive committee which functions for the assembly between annual meetings.

Public works

The committee on public works was handicapped in making its report by the confusion incident to the President's reorganization plan, which was announced only a few days before the meeting. However, a resolution was adopted recommending that, in principle, all engineering activities of the federal government should be grouped under a single head but making no commitment on details of the proposal.

In the field of conservation and utilization of natural resources, the committee presented a lengthy list of subjects upon which it is desirable to stimulate engineering discussion and formulate opinion. It was decided to have the council staff take whatever steps seemed advisable to build up an interchange of engineering opinion between Washington headquarters and the local societies for the purpose of determining the consensus of engineering thought throughout the country on the widest possible basis.

The slow progress that has been made in surveying and mapping the United States, despite the provisions of the Taylor Act, was considered extremely disappointing by the committee studying that question. Upon the committee's recommendations, the council reindorsed the program and advised each local member body to bring to the attention of its Congressman the local defects in mapping. It is hoped that by this method Congress may be brought to a new realization of the importance of additional appropriations for this activity.

The committee charged with a general survey of engineers and engineering re-

(*Continued on page 110*)

Rivers in Flood In Middle West

Flood stages reached at Pittsburgh — Levees break on St. Francis River — Ohio River rising

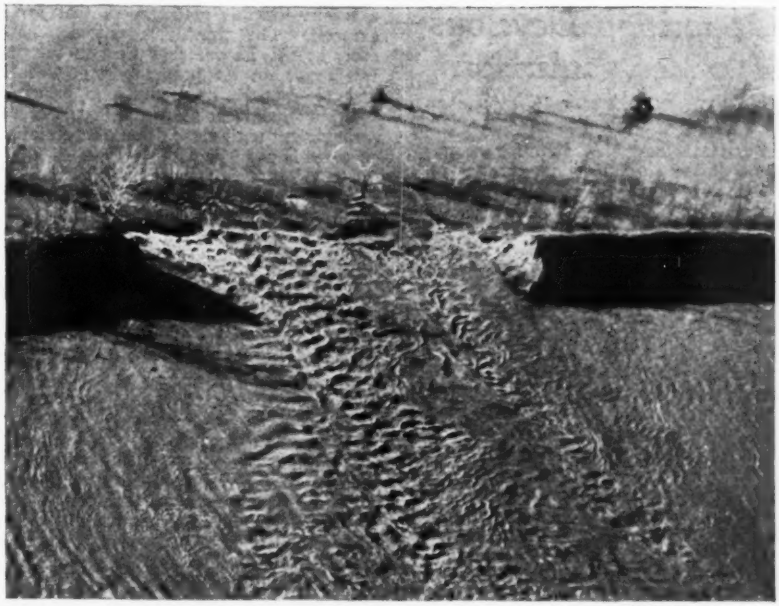
Heavy rains throughout the Mississippi Valley, which continued all last week, began by Jan. 15 to send the Mississippi and its larger tributaries climbing toward flood stages. However, as late as Jan. 19, conditions approximating those of last spring had not appeared. The worst damage appeared to be concentrated in Missouri and Arkansas where the flooded St. Francis had broken the levees in a number of places, flooding low lying farm land and washing out the tracks of the St. Louis and San Francisco Railroad. In Pittsburgh, the Monongahela and Allegheny rose 2.4 ft. above flood stage, flooding the Duquesne Way and basements of some stores along it but without doing any serious damage.

Flood conditions developed first on the St. Francis River, levees going out on Jan. 15 near Rombauer, Mo. At the same time the nearby Black River was flooding the region around Poplar Bluff, Mo. The Ohio on that day was climbing toward flood stages at Cincinnati, but the Mississippi itself showed no signs of danger. Also rising were the Wabash, White and Kaskaskia Rivers.

On the 16th the rain stopped and the weather turned colder, causing a general recession of river stages. However, on the 17th, a general resumption of rainfall throughout the midwest brought the Ohio, White, St. Francis, Kaskaskia and Wabash rivers above flood stages. The St. Francis rose to within 6 in. of the high mark of 1935, and above that of 1927. The Wabash reached 23.8 ft., 7.8 ft. above flood stage, and the west fork of the White River at Elliston, Ind., reached a stage of 30.1 ft., the highest since 1913. The Ohio River rose at Cincinnati to a stage of 49.1 ft., and at Portsmouth, Ohio, rose 3.7 ft. in a 24 hr. period to a stage of 44.7 ft.

Rivers continued to rise on the 18th, as rains and warm weather continued. The St. Francis broke through the levees in Arkansas as the flood crest moved downstream. At Cincinnati the Ohio reached 55 ft. by late afternoon and was expected by meteorologists to reach 60 ft. by Thursday.

Floodwaters entered Pittsburgh on January 19, when the Monongahela and Allegheny Rivers rose to 27.4 ft., 2.4 ft. above flood stage. Store and theatre basements were flooded along the Duquesne Way, but little damage has been done and pumps were able to handle the water. It was not expected that the rivers would rise higher than 28 ft.



Wide World photos.

A BREAK IN A MINOR LEVEE on the St. Francis River about 10 mi. north of Fisk, Mo. This break occurred January 15.

Japan Begins Work On Railway Tunnel

Ground was broken on Sept. 19 for the first construction shaft of a 3,600 ft. tunnel under the Kwammon Straits between Moji and Shimonoseki, Japan. The single track railway tunnel will take the place of a ferry connection between Moji which is the northern terminus of the railway line on the island of Kyushu and Shimonoseki which is the southern terminus of the lines on the Japanese main island. It is estimated that the railway tunnel will cost about $5,000,000.

It was originally planned to build a double track tunnel, but financial difficulties intervened. It is now planned that if no serious difficulties are encountered in driving the first shaft, a second shaft will be built. The single track tunnel would permit the passage of only about 60 trains a day.

Geologists expect that difficulty will be encountered in the construction of the tunnel. Three faults, each about 20 ft. wide, have been found running from east to west beneath the bed of the straits. These faults were located by means of elasticity tests.

303-Mile Tunnel Proposed Under Allegheny

A proposal submitted to the War Department by a resident of Cleveland would provide for a subway from Conneaut, Ohio, to Baltimore, Md., intended to provide the Great Lakes with an outlet to the sea.

The project embraces a double track electric freight line, a vehicle highway 100 ft. wide, and a water tunnel at sea level. It was proposed that the 303-mile tunnel be named the George Washington speeding seaway. The sponsors of the project stated that construction of the tunnel could be done at a cost of $375,000,000.

The War Department considered this cost estimate somewhat low and stated that it would not consider the project unless compelled to do so by a special Congressional order.

Extension of New York Subway To Worlds Fair Urged

Construction of an extension of the Queens line of the municipally owned New York City Independent Subway system to the grounds of the 1939 New York World's Fair and enlargement of the Willets Point station of the Flushing line operated jointly by the I.R.T. and the B.M.T. have been recommended by the chairman of the Board of Transportation and the chairman of the Transit Commission of the city in a joint report. The Willets Point station of the jointly operated line is at the fair grounds.

It is estimated that the cost of construction of the extension to the municipally owned line would be about $1,200,000. Under the proposed plan, a double track line about 8,400 ft. long would be built from the Independent Subway station on Queens Boulevard into the fair grounds and along the east side of the grounds to the Horace Harding Boulevard station.

The cost of additions to the Willets Point station of the jointly operated line would be about $650,000.

The report stated that it would not be possible completely to amortize the cost of the subway extension during the period of the fair. It was estimated that, in 1939, 13,000,000 extra passengers would be carried by the Independent subway system on account of the fair. This would provide a revenue of $650,000. The estimated additional expense for about 1,700,000 car-miles of operation would be $240,000, leaving a net operating revenue of $410,000. Assuming the 1940 attendance at the fair to be 80 per cent of that in 1939, the net operating revenue for the two years would be $750,000. The remainder of the $1,200,000 capital cost should be regarded, the report held, as a contribution by the city to the world's fair.

Opposition Develops To Reorganization

Washington Correspondence

President Roosevelt's plan for reorganization of the executive department of the federal government has brought forth a good deal of opposition. Although the President has made it clear that no detailed changes will be considered until after the general reorganization law has been passed and careful studies have been made, discussion, in and out of Congress, centers around possible regrouping of government agencies.

Since the only hope of a successful reorganization will lie in securing broad authority from Congress before any detailed recommendations are made, the President is certain not to reveal any of the plans he may already have in mind. For this reason there can be only speculation as to what the executive might do if authority is granted to make changes. Any thought that he might leave undisturbed a bureau like that of Public Roads because of its essentially supervisory character can be nothing but conjecture at this time.

From what little can be learned of the President's position, it appears that there would be no disposition to disturb the work of the Corps of Engineers. He does not lose sight of the fact that the engineers of the army are needed for the service they would be able to perform in time of war. In times of peace they must be kept busy and must have practical experience in the kinds of work they may be expected to do in case of war. It is believed the President will ask that the Corps of Engineers be given enough work of the character it is now being assigned to keep it busy. All other public works, including any excess of river and harbor work, beyond that left to the corps, would probably be assigned to the proposed Department of Public Works.

In this connection, as in others, a tendency toward log-rolling is likely to develop. Throughout the Mississippi valley, and in other areas with numerous river and harbor projects, interests friendly to the Corps of Engineers will oppose the reorganization law for fear that river and harbor work may be taken away from the army engineers. Friends of the corps in Congress will be quick to join hands with other legislators who, for instance, fear that the Forest Service might be moved out of the Department of Agriculture into the Department of Conservation. In the aggregate, those who would forestall this or that particular change constitute a difficult opposition to overcome. Ordinarily such an opposition would be invincible, but with the unusually large majorities in the two houses of Congress, and with the personal prestige of an overwhelming popular vote, President Roosevelt has a chance to accomplish more than any predecessor was able to.

However, some observers at the meeting of the American Engineering Council think that only disappointment will result if hope of a public works department is aroused. They doubt that there is any determined desire on the part of the President to secure a public works department. He really wants the social welfare department and simply asked for two departments as a means towards getting one, that group suspects. The prevailing attitude, however, at the Engineering Council meeting was to accept the proposal in good faith and to support its underlying principle, reserving judgment as to the details of rearrangement until more definite information on them is available.

The Brownlow report is regarded, in Congress, as an able document. There is no disposition to charge that the three authors were influenced by the President to bring out the kind of a report he specified. However, in spite of the outstanding reputations of the authors of the report, there is a feeling that they probably know less about the functioning of executive agencies than do many members of Congress. There is a feeling that the report displays weakness in trying to place all independent agencies under a regular department. Insurmountable obstacles are seen in the way of any such grouping of the Board of Governors of the Federal Reserve System, for instance, or of the Interstate Commerce Commission. Opposition to the proposed changes in the office of the Comptroller General is not as strong as had been anticipated.

No bill has as yet been introduced carrying the provisions of the Brownlow plan. Such a measure, it is understood, will make its appearance promptly.

John Gregory Dies

John H. Gregory, New York City consulting engineer and professor of civil and sanitary engineering at Johns Hopkins University, died suddenly on January 18 at the age of 62. Professor Gregory had made preparations to attend the annual meeting of the American Society of Civil Engineers on Jan. 20. He was for many years a member of the Board of Direction of the A.S.C.E.

A fuller biography of Professor Gregory will appear in next week's issue.

PWA Approves Five Projects

Five projects with a total estimated construction cost of $1,325,000 have received grants from the PWA amounting to $596,000. Three of the projects are for highway improvements in San Patricio County, Texas. These projects, costing $605,000, have received grants of $272,000. San Patricio County's highway funds were lost in a bank failure in 1931.

The fourth grant, for $228,000, went to the Virginia State College for Negroes at Petersburg, Va., for construction of buildings costing $507,000. This was accompanied by a loan of $279,000.

The fifth was a grant of $96,000 to the Board of Education of Cleveland County, N. C., for three new school buildings and one gymnasium, estimated to cost $213,000. In applying for this grant, the applicant said that the erection of the three buildings was more important than a power project at Shelby, N. C., for which an allotment for a grant of $132,000 was made on October 10, 1936. The power project will be abandoned and the money returned to the Public Works Administration.

Louis C. Hill Is Elected To A.S.C.E. Presidency

The election of Louis C. Hill as president of the American Society of Civil Engineers was announced on January 20 at the annual meeting of the Society.

Mr. Hill was born in 1865. He graduated from the University of Michigan in 1886 with the degree of Bachelor of Science in Civil Engineering, and in 1890 he received the degree of Bachelor of Science in Electrical Engineering. In 1911 the University of Michigan conferred upon him the honorary degree of Master of Engineering.

From 1890 to 1903, Mr. Hill was Professor of Hydraulics and Electrical Engineering at the Colorado School of Mines. In 1903 he entered the U. S. Reclamation Service as an engineer, later holding the positions of project engineer and supervising engineer. While with the Reclamation Service, Mr. Hill was in charge of construction of the Salt River project including Roosevelt Dam), the Yuma project, and projects in New Mexico and Texas and was also in general charge of the Colorado River Basin.

Mr. Hill entered private practice in March, 1914, and since that time has been retained as consulting engineer by the U. S. Bureau of Reclamation. He is a member of the consulting engineering firm, Quinton, Code, & Hill-Leeds & Barnard, of Los Angeles, Calif.

In the course of his consulting practice, Mr. Hill has been connected with many engineering projects, among the more important of which were the Gibraltar Dam on the Santa Ynez River, the Pine Canyon Dam on the San Gabriel River, the Big Tujunga Dam on the Big Tujunga River, Bouquet Dam, and Sutherland and El Capitan Dam. He has been consulting engineer for the State of California on various dams, and was consulting engineer on the Yaqui River project in Mexico.

At present Mr. Hill is consulting engineer to the U. S. Engineers on fourteen dams near Zanesville, Ohio, on the Conchas Dam in New Mexico, the Tygart Dam in West Virginia, the Bluestone Dam, also in West Virginia, the Sardis Dam in Mississippi and the Fort Peck and Bonneville Dams. He is a member of the board of consulting engineers on Boulder Dam, on Imperial Dam and on the All-American canal.

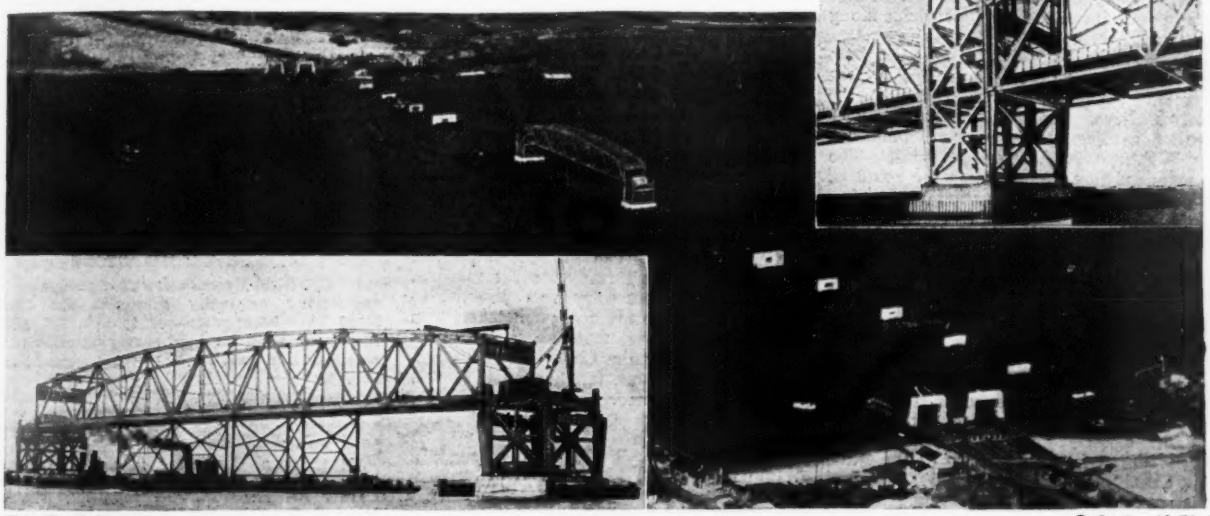
SECOND LONGEST LIFT SPAN PLACED AT NEW YORK

WHEN the 540-ft. lift span of the Marine Park bridge, second longest ever built, was floated into position across the channel entrance to Jamaica Bay in the early morning of Jan. 12, the Rockaway Inlet crossing which will connect Brooklyn with Jacob Riis Seashore Park in Queens began to define its ultimate shape. As shown in the air view, the lift span is at the center of the bridge. From the lift span to each shore, there will be a 540-ft. through truss (duplicate of the lift span), a continuous deck truss of two 214-ft. spans, a continuous deck truss of three spans (190-176-160 ft.), and a simple span of 97 ft. Exceeded in length only by the 544 ft. Cape Cod Canal railroad span and in weight only by the Albany-Rensselaer highway span (2,250 as against 2,750 tons), the Marine Parkway lift span is of major importance. It is further notable because of its open-mesh steel deck and the unusual architecture of its towers.

Erection of the lift span is following a somewhat different procedure than has heretofore been used, based principally on the desire of the erector to use the lift span as a platform to support temporary erection towers whose derricks will build the bridge towers to their full 200 ft. above the masonry. Ordinarily these temporary towers would be placed on the flanking spans, and the bridge towers would be erected before placing the lift span, but in this case one of these openings had to be maintained for shipping while the lift span was being assembled. Also, the piers for the flanking spans were not completed at the time it was desired to start steel erection.

As shown in the lower view, the towers were built initially only to deck level, slightly above the brackets which support the lift span end-derricks. The stiffleg derrick shown was used to assemble the lift span on four 50-ft. high supporting bents set on two 325x38-ft. car floats, the fabricated members being brought in by barge and the span moved past the derrick until assembly was complete. Tugs then maneuvered the span into position at high tide, and jacks placed on the lower brackets lifted it clear and then lowered it into position. The two flanking spans will be erected in the same way. The deck truss spans will be assembled complete on car floats at the railroad yard about five miles away and towed to the site.

The bridge is being erected by the American Bridge Co. The Frederick Snare Corp. built the foundations. The bridge was designed by Waddell & Hardesty, consulting engineers, New York City. For the Marine Parkway Authority, Robert Moses is commissioner, Madigan-Hyland consulting engineers, and Aymar Embury II, consulting architect.



Wide World Photo *Rudy Arnold Photo*

Armco Plans Unusual Building To House Research Work

Porcelain enameled steel sheets, stainless steel trim, and glass blocks will supplant more conventional materials in the walls of a new research laboratory to be built by the American Rolling Mill Co. at Middletown, Ohio, according to an announcement made by Charles R. Hook, president, on Nov. 16. The one-story laboratory building, to cost $260,000 will cover 42,000 sq.ft. and has been designed and will be erected by the Austin Co., of Cleveland. The frame will be welded.

Six hundred lineal feet of porcelain enamel side walls, cream colored with contrasting decorative pilasters and bands of stainless steel, will enclose the three street sides. Between the pilasters there will be broad areas of glass blocks in which horizontal steel sash with clear glass will be set. Additional daylight will be furnished through vertical saw-tooth monitors closed in with glass blocks in continuous sections, 175 ft. long and 10 ft. high. The entire building is being equipped for summer and winter air conditioning.

A massive square central entrance tower will dominate the principal facade. Vertical shafts of glass blocks, recessed between narrow strips of porcelain, will extend upward for its full two-story height from a semi-circular marquee of stainless steel at the portal.

Army to Establish Laboratory In New York City

The ordnance department of the U. S. Army will establish, early this year, a precision gage instrument laboratory for the New York area at New York University. The laboratory, which will be the only one of its kind in the metropolitan area, will be used in the testing of various tools, instruments, mechanisms, and other equipment for military purposes. It will be available also to students of engineering.

Prof. Carlos De Zafra of the department of mechanical engineering at N. Y. U. and chief of the gage division of the New York Ordnance District of the Army, will be the director of the laboratory.

Waterworks Section Forms Sewerage Works Group

At the recent Denver meeting of the Rocky Mountain section of the American Water Works Association steps were taken to form a Rocky Mountain Sewage Works Association, which is to hold meetings at the same times as the section and in conjunction with it. R. W. Gelder, consulting engineer, Greeley, was elected president, and Dana E. Kepner, Denver, secretary-treasurer. Representatives to the Federation of Sewage Works Associations are L. C. Osborn, city engineer, Loveland, Colo., and J. W. McCullough, consulting engineer, Denver.

A heavy majority affirmative vote was cast for licensing of water superintendents and plant operators. The section voted unanimously to approve the action of the general policy committee with reference to reorganization of the staff at AWWA headquarters. Paul S. Fox, state public health engineer, New Mexico, is the new chairman and B. V. Howe, Colorado state sanitary engineer, was reelected secretary-treasurer.

Washington Highlights

By Paul Wooton

Construction of a Nicarauguan Canal connecting the Atlantic and the Pacific would be authorized by a bill introduced by Senator McKellar. The measure would authorize floating federal loans up to $200,000,000 in 3 per cent tax exempt bonds to pay for starting construction of the canal.

No mutual concessions between the United States and Canada are immediately in prospect on matters pertaining to their interests on international streams. Among the matters that will eventually come up for discussion is the desire of the United States to secure rights on the Skagit River that will allow the use of Canadian land for reservoir purposes. Canada wishes to obtain similar rights on the American portion of the Kootenai River. On the Red River of the North there is a pollution problem on each side of the border which will require common action. These are in addition to the many problems along the St. Lawrence.

Further study of cost estimates for the Bossum Kingdom Dam, part of the Brazos River flood control and power project in Texas, has been recommended by WPA Administrator Hopkins. The recommendation was made as the result of his meeting with a delegation urging immediate action. An allotment of $3,500,000 was made by WPA for construction of the dam and turned over to the Corps of Engineers to supervise construction. Further foundation exploration and more detailed design study has resulted in a subsequent cost estimate by the Corps of Engineers of $7,000,000, and construction has been suspended pending further study to decide between the estimates.

Gulf Coast interests are supporting authorization for construction of the Florida Canal on the grounds that the canal is necessary to protect them against the threat of competition from Great Lakes cities if the St. Lawrence waterway project should be approved. Senator Overton of Louisiana, an active opponent of the St. Lawrence project, thinks that that project "will hang as a menace over the Gulf Coast even should the treaty not be ratified at this session of Congress. If the construction of the Florida Canal can be assured, New Orleans then will be in a better position to compete with Great Lakes ports if they should be made accessible to ocean-going ships."

Chicago Sanitary District Makes Semi-Annual Report

The Sanitary District of Chicago, in its semi-annual report to the Supreme Court, required by a decree of 1930, relative to progress on the sewage treatment works and to the amount of diversion from Lake Michigan, indicates that 41 per cent of the total sewage is now being treated and that the net diversion, limited by the court to 5,000 sec.-ft., averaged 4,861 sec.-ft. up to Dec. 31, 1936.

The amount of sewage treated is essentially the same as was given in the report for the previous six months. During the last six-months period construction expenditures have totaled $9,576,000; an additional $1,529,000 has been earned by contractors but has been retained until final completion.

Up to date, $135,284,000 has been spent on the sewage treatment works, and $64,158,000 is still to be spent.

Engineering Council Meets in Washington

(*Continued from page* 106)

ported that it had been cooperating with the Labor Department Bureau of Labor Statistics on a study of employment in the profession, compensation, and educational effects upon these two points. Questionnaires have been circulated to a large number of engineers and about 53,000 replies received. Some results have already been published, others will follow, and it is planned to assemble a complete report in the form of a bulletin in the near future.

There was considerable discussion of means of obtaining publicity for the engineering profession. The executive secretary reported that an arrangement had been made with the Science News Service for a monthly release to daily newspapers to be prepared in cooperation with the American Engineering Council.

A committee report on the subject of consumption, production, and distribution was presented by title only, because publication difficulties had made it impossible to have the report ready for the meeting. The executive secretary was directed to carry forward plans for publication with the understanding that no endorsement of the report by the Council was implied.

All officers whose terms expired at this time were reelected.

First Highway Surveys Near Completion

A few of the state-wide surveys of highway conditions and problems, now under way in about forty states with the assistance and backing of the U. S. Bureau of Public Roads, are almost completed. In most of the states, however, the work is still far from nearing completion.

Complete and detailed data on the number and condition of highway bridges in the country is the chief objective of the survey. It is hoped to obtain material which will permit the drafting on a scientific basis of a comprehensive replacement program for the entire country.

Another objective of the survey is to obtain a comprehensive picture of all railroad track abandonment and of the mileage and type of roads that should be built to replace the abandoned trackage. Work on this subject was originally started by the Bureau of Public Roads, but was dropped in order to avoid duplication when the states began their surveys.

When the work is finished, state officials are expected to issue factual reports, and it is possible that the Bureau of Public Roads will complete the task with a definite study of the whole situation based upon the findings in the various states.

SOCIETY CALENDAR

AMERICAN WOOD PRESERVERS ASSOCIATION, annual meeting, New Orleans, La., Jan. 26-28.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Detroit, Mich., Jan. 27-29.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Montreal, Canada, Jan. 29-30.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, annual convention, San Antonio, Texas, Feb. 15-17.

AMERICAN CONCRETE INSTITUTE, annual meeting, New York, N. Y., Feb. 23-25.

HIGHWAY CONFERENCE, UNIVERSITY OF ILLINOIS, Urbana, Ill., March 3-5.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, annual meeting, Chicago, Ill., March 16-18.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS, annual meeting, New Haven, Conn., Feb. 16-17.

SOUTHWEST ROAD SHOW AND SCHOOL, Wichita, Kansas, Feb. 23-26.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, annual convention, New York, N. Y., Feb. 24-26.

MINNESOTA FEDERATION OF ARCHITECTURAL AND ENGINEERING SOCIETIES, annual convention, St. Paul, Minn., Feb. 26-27.

NEW YORK STATE ASSOCIATION OF HIGHWAY ENGINEERS, annual convention, Albany, N. Y., March 4-6.

NEW JERSEY SEWAGE WORKS ASSOCIATION, annual meeting, Trenton, N. J., March 11-12.

LICENSE EXAMINATIONS

NEW YORK Examinations for professional engineering originally scheduled for Jan. 25-27 have been postponed to Feb. 1-3, and the examination for land surveying originally scheduled for Jan. 28 has been postponed to Feb. 4.

At the Jan. 6 meeting of the CLEVELAND CHAPTER of the AMERICAN SOCIETY OF CIVIL ENGINEERS, the following officers were elected: president, Arthur F. Blaser; vice-president, Frank L. Gorman; secretary-treasurer, John H. Anderson.

Officers elected by the HUNTINGTON CHAPTER of the WEST VIRGINIA SOCIETY OF PROFESSIONAL ENGINEERS include: president, Earl E. Teeter; vice-president, H. L. Vandamant; secretary-treasurer, John C. Sprague.

The SOUTH CAROLINA SOCIETY OF ENGINEERS elected the following officers at a meeting on Jan. 7: president, Louis S. LeTellier; vice-president, J. S. Williamson; secretary-treasurer, A. E. Johnson; directors, D. D. Curtis, J. M. Martin, and Julian B. Weston.

The Board of Directors of the NEW YORK STATE ASSOCIATION OF HIGHWAY ENGINEERS elected the following officers at their annual meeting: president, Francis D. McKeon; vice-president, John F. Jahn; secretary-treasurer, E. W. Dayton.

New officers of the CANADIAN CONSTRUCTION ASSOCIATION elected at the Jan. 10 meeting are: president, F. G. Rutley; vice-president, Joseph Wilde; Eastern vice-president, William Nonneman; Mid-Western vice-president, Cecil Gunn; Western vice-president, Walter Leek; honorary treasurer, I. L. Anthes; honorary secretary, E. G. Montgomery.

The NEW JERSEY ASSOCIATION OF PROFESSIONAL ENGINEERS AND LAND SURVEYORS at a Jan. 16 meeting elected the following officers: president, Beale Schmuckler; first vice-president, Gerald W. Knight; second vice-president, Victor C. Gelineau; secretary-treasurer, Ernest F. Weeks.

Personals

ADHEMAR LAFRAMBOIS has been appointed chief engineer of the Eastern Canada Steel & Iron Works. Mr. Laframbois was formerly city engineer of Lachine, Quebec.

ROBERT S. CRANE, WPA engineer for Fayette and Highland counties, Ohio, has resigned to enter private employment.

JOHN T. LAFFAN, JR. has been promoted from assistant engineer to chief engineer in the materials bureau of the Louisville, Ky. engineering department.

ROYAL H. SILLITOE has resigned his position as county engineer of Trumbull County, Ohio, to join the engineering staff of the Republic Steel Co.

SHERMAN SMITH, assistant professor of civil engineering at the University of Toledo, has been appointed city traffic manager of Toledo, Ohio.

HENRY E. WOLF has been appointed city engineer of Fairbanks, Alaska. Mr. Wolf was formerly PWA inspector at Anchorage, Alaska.

RICHARD M. BATCH and HAROLD A. STAPLETON have been admitted to the consulting engineering firm of H. P. Jones & Co., with which they have long been associated.

J. H. LAKE has been appointed chief highway engineer of South Dakota, succeeding Fred Schrader. Mr. Lake held a similar position in 1931 and 1932, and has recently been a district WPA engineer.

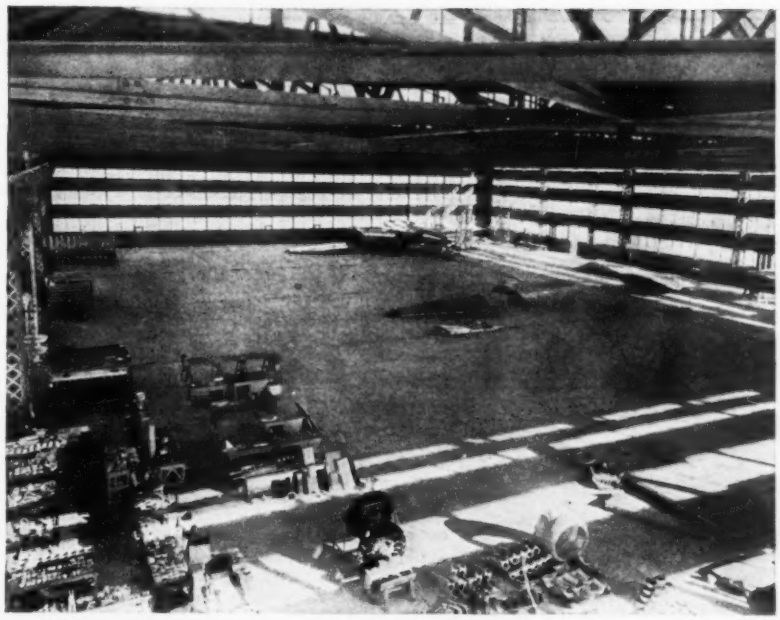
FELIX J. KEAVENY has completed his work as structural designer for the buildings of the new town at Gamboa, Canal Zone, which will house the dredging division of the Panama Canal.

SAMUEL KOFFSKY has resigned his position as assistant supervisor of operations for the WPA in District 2, New York State, and will become consulting engineer to the Simmons Machine Tool Corporation, of Albany, N. Y.

LEON ARONOWITZ, for eleven years engineer in charge of accidents and statistics and safety director for the Bureau of Motor Vehicles, New York State, has been appointed director of the new New York State Traffic Commission.

JOHN C. WATTS, who was formerly district engineer for the TERA in connection with CWA and ERB projects in Buffalo, N. Y., has been appointed acting district director of the WPA in Buffalo. Mr. Watts is a graduate of Rensselaer Polytechnic Institute and was city engineer of Troy, N. Y., from 1924 to 1928.

ARTHUR MACNAMARA has been appointed deputy minister of the Department of Public Works of the Province of Manitoba; M. A. LYONS, chief engineer of the Good Roads Board of Manitoba, has been appointed highway commissioner, and THOMAS T. WILSON has been appointed chief engineer of the Good Roads Board.



Austin Co. photo

AIRPLANE FACTORY HAS LONG-SPAN ROOF TRUSSES

INSIDE one of the largest unobstructed working areas ever provided for industry, the Boeing Aircraft Co. will soon be assembling nine of its new four-engined army bombers at one time. Recently completed adjacent to Boeing Field, Seattle, Wash., the company's new assembly plant consists of one room 204x304 ft. in plan, unobstructed by columns, and 35 ft. high to the lower chords of the seven 44-ton trusses which support a roof of five 10-ft. sawtooth monitors. Framing between the main 204-ft. span trusses consists of 50-ft. span trusses spaced 20 ft. apart.

Four continuous bands of horizontal steel sash surround the building on all sides, including the steel doors which face the flying field and provide a 195x35 ft. opening. Brick is used below the sill of the lower band of sash, while upper areas separating the sash bands consist of two layers of metal sheathing separated by one inch of insulation, a construction calculated to give temperature protection equivalent to a 12-in. brick wall. Steel girts bolted to the latticed columns support the wall enclosure and insure maximum salvage in the event of expansion which is possible on either side of the building or toward the rear.

The unit now completed is strictly an assembly shop and is the first improvement on a new 28-acre site recently acquired. It will receive parts and partially completed planes from the main Boeing plant about a mile away by barge via the Duwamish waterway which runs alongside the main plant and along the rear of the new site, where a dock 50x75 ft. has been built. Other parts will be delivered over a railroad spur bringing freight cars directly onto a concrete apron outside the plant. Motors, wings, fuselage, and other airplane parts will be handled inside the assembly shop on a monorail system suspended from the bottom chords of the long roof trusses. All electric, water, gas, steam, and compressed air lines are placed in concrete tunnels below ground.

The Austin Co. of Cleveland designed and erected the plant.

Obituary

EMERY C. READ, credited with being the oldest active surveyor and civil engineer in western Pennsylvania, died in Franklin, Pa., on Jan 10, aged 82.

SAMUEL D. FLOOD, 69, retired consulting engineer, died on Jan. 10 in Kenilworth, Ill. Mr. Flood was a graduate of the Massachusetts Institute of Technology.

O. N. MUNN, former engineer and superintendent of the port of Bellingham, Wash., and for many years connected with the county engineer's office at Bellingham, died on Jan. 6 at the age of 53.

JOHN W. THOMPSON, who was formerly connected with the U. S. Engineers, and has more recently been active in the development of the Trenton, New Jersey, waterfront, died in Trenton on Jan. 5 at the age of 59.

LUTHER DEAN, formerly city engineer of Taunton, Mass., died in Boston on Jan. 9 at the age of 70. Mr. Dean was for some time connected with the J. G. White and the Stone & Webster engineering organizations. Some years ago he retired from engineering work and engaged in financial activities.

WALTER E. HOWDEN, superintendent of the Madison County, Ill., highway department since 1914, died on Jan. 4 in Edwardsville, Ill., aged 50.

JAMES C. STEVENSON, 51, vice-president of the H. L. Stevens Co., architectural engineers of Chicago, died on Dec. 29 at Winnetka, Ill. Mr. Stevenson, a graduate of the University of Texas, was at one time assistant city engineer of Galveston, Tex., and was for a time connected with the engineering department of the Santa Fe Railroad.

JOHN H. PEARSON, 90, died on Jan. 6 in West Newton, Mass. Before his retirement 15 years ago, Mr. Pearson served for about 15 years as chief engineer and

superintendent of Fort Hancock, N. J. Earlier, Mr. Pearson had served as city engineer of Louisville, Ky., and as chief engineer of the Louisville, Cincinnati, & Lexington Railway.

HENRY R. BURT, president and one of the founders of the North-Eastern Construction Co. of New York City, died in that city on Jan. 1 at the age of 57. Mr. Burt graduated from Columbia University School of Engineering in 1901 and participated in the formation of the North-Eastern Company in 1904. In 1928 Mr. Burt became president of the company.

EDWARD H. LEE, former president of the Chicago and Western Indiana Ry., died in Chicago on Jan. 11 at the age of 73. Mr. Lee was educated at Ohio University and the University of Wooster. In 1887 he became office engineer for the Elgin, Joliet, & Eastern Ry. and from 1889 to 1893 served as chief engineer of that line. After several years in contracting work and with the Sanitary District of Chicago he returned to railroad work in 1898 on grade separation work in Chicago for the Chicago & Western and the Chicago Belt Ry. In 1910 he became chief engineer of these companies and in 1914 vice-president and chief engineer. In 1926 Mr. Lee became president of both companies and held that position until he retired in 1931. Mr. Lee was a past president of the Western Society of Civil Engineers.

LARGER AWARDS FOR THE WEEKS

New capital for the week includes state and municipal bond sales, $9,316,000 and corporate security sales, $192,000. RFC sale of PWA bonds transferred $4,936,000 from federal to private investment financing but did not increase the total new capital outstanding.

Steam power unit, Schuykill Station, Philadelphia Electric Co., Philadelphia, Pa.	$5,000,000
School, 3-story, Frankford and Stanwood Sts., Philadelphia, Pa.	1,047,000
Library, University of Virginia, Charlottesville, Va.	654,000
Highways, Florida	758,000
Highways, Illinois	1,021,000
Highways, Illinois	1,251,000
Highways, New York	1,123,000
Highways, North Carolina	597,000
Highways, Texas	823,000
Highways, Texas	957,000
Highways, Texas	1,622,000
Bridges, Pennsylvania	576,000
Lonyo Interceptor, Contracts LI-1, Sect. 1 and LI-2, Sect. 2, Department of Public Works, Detroit, Mich.	1,128,000
Dam 13, Mississippi River, U. S. Engineers, Clinton, Iowa	2,384,000
13,500 tons steel rail, St. Louis and San Francisco Railroad, Missouri	600,000

CONSTRUCTION STATISTICS FOR THE WEEK

ENGINEERING construction awards for the week total $43,941,000 of which private is $15,317,000; public, $28,624,000; federal, $5,453,000 and state and municipal, $23,171,000. Corresponding values last week are: total, $43,889,000; private, $19,584,000; public, $24,305,000; federal, $2,863,000 and state and municipal, $21,442,000. Corresponding values for a year ago are: total, $45,543,000; private, $17,047,000; public, $28,496,000; federal, $4,305,000 and state and municipal, $24,191,000.

Public awards increased slightly this week at the expense of private work. As to classes of construction, a sharp gain was shown in highways and losses from last week in sewerage, bridges, industrial buildings, and commercial buildings. The classified sub-totals are: commercial buildings, $4,550,000; industrial buildings, $9,267,000; public buildings, $7,030,000; highways, $10,423,000; bridges, $2,991,000; sewerage, $2,991,000; waterworks, $908,000; earthwork, drainage, $2,986,000; unclassified, $2,795,000.

INDEX NUMBER

ENR Cost	1913 =100	1926 =100	ENR Volume	1913 =100	1926 =100
Jan., 1937	223.45	107.41	Dec., 1936	206	90
Dec., 1936	220.67	106.07	Nov., 1936	159	70
Jan., 1936	199.48	95.89	Dec., 1935	254	111
1936 (Av.)	206.46	99.24	1936 (Av.)	185	81
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50

CONTRACTS
(Thousands of Dollars)

	Weekly Average Jan. 1936	Prev. 4 Weeks	Week Jan. 21 1937
Fed. Government	$10,437	$2,513	$5,453
State and Municipal	38,655	18,870	23,171
Total public	$49,092	$21,383	$28,624
Total private	8,617	22,920	15,317
Week's total	**$57,709**	**$44,303**	**$43,941**

Cumulative to date:
1936 (4 weeks) $239,527,000
1937 (3 weeks) $128,277,000

Note: *Engineering News-Record* reports waterworks and earthwork, reclamation or waterways projects of $15,000 and over in size; other public works, $25,000, industrial buildings, $40,000; other buildings, $150,000 and over. The figures above represent the volume of contracts and large force account projects throughout the U. S. that are of these minimum sizes or over.

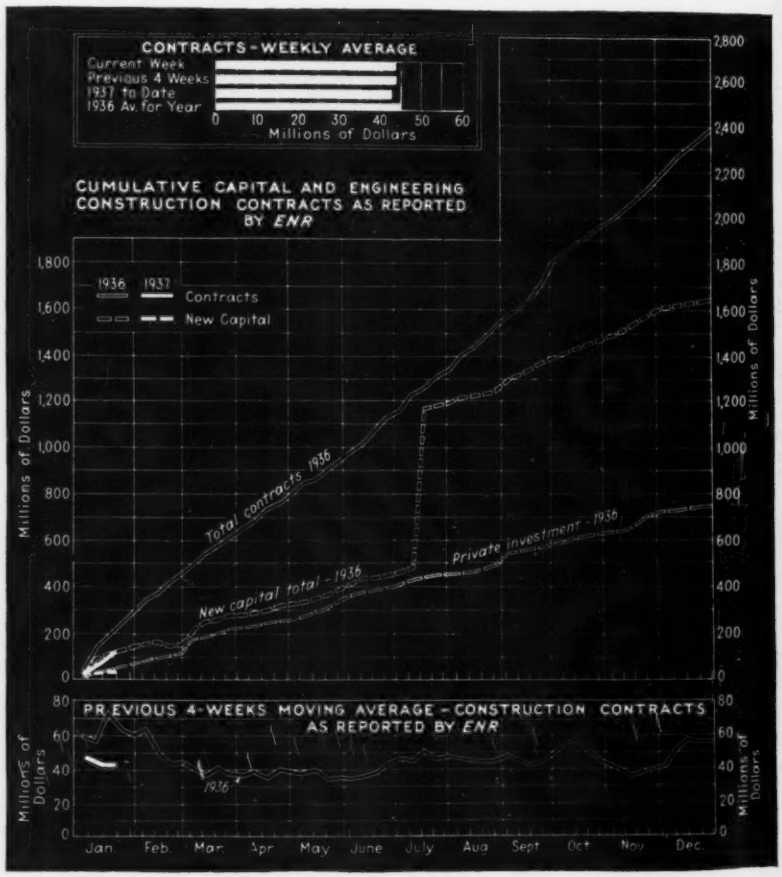
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1937	Week Jan. 21	Cumulative
Private investment	**$14,444**	**$27,762**
State and municipal bonds	14,252†	25,430†
Corporate securities	192	2,332
Federal financing	**—4,936†**	**—4,061†**
PWA non-federal Projects	.....	875
Total non-federal	**$14,444**	**$28,637**
Federal projects	.....	.....
Total	**$14,444**	**$28,637**

Cumulative to date:
1936 (4 weeks) $146,651,000
1937 (weeks) $28,637,000

Note: These figures include private bonds and stocks sold for new construction purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities. RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

† Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.


CONTRACTS - WEEKLY AVERAGE
Current Week
Previous 4 Weeks
1937 to Date
1936 Av. for Year
0 10 20 30 40 50 60
Millions of Dollars
CUMULATIVE CAPITAL AND ENGINEERING CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1936 1937
Contracts
New Capital
Millions of Dollars
Total contracts 1936
Private investment - 1936
New capital total - 1936
PREVIOUS 4-WEEKS MOVING AVERAGE - CONSTRUCTION CONTRACTS AS REPORTED BY ENR
1936
Jan. Feb. Mar. Apr. May June July Aug. Sept. Oct. Nov. Dec.

Dollars